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ABSTRACT

The statewide plan for computing resources in Illinois higher education is presented in this document. Chapter 1 discusses the history of this plan encompassing the board of higher education involvement, State Government planning, legislative actions, plan development, and a prospectus. Chapter 2 presents the procedure used to produce this report. Chapter 3, a summary of findings and recommendations, covers administration, instruction, research, computer-assisted instruction, public junior colleges, private colleges, cooperation, implementation, control, and priorities. Chapter 4 discusses the basis for the recommendations including the higher education environment, historical and current demands for computing funds in Illinois, future funds demand for public university computer resources, characteristics of computer service, instructional demand for computing service, research for computing services, administrative demand for computing service, and computer networks. Chapter 5 presents criteria for recommendations while chapter 6 presents recommendations concerning a public-interest corporation, service priorities, consolidation approaches, long-term funding, pricing for computer services, data processing, systems development, and a new approach to data processing activities, as well as hardware selection. (MJM)

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THE STATEWIDE PLAN FOR COMPUTING RESOURCES IN ILLINOIS HIGHER EDUCATION

Prepared By:

The Task Force for Statewide Computer Plan Development:

David F. Hyman, Board of Higher Education Staff
Gary L. Bemiller, Board of Higher Education Staff
John L. Gentile, Department of Finance
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April 17, 1972

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CHAPTER I

HISTORY

Board of Higher Education Involvement

The Illinois Board of Higher Education first became active in the development of a statewide plan for computer resources during 1969. This activity was the result of the knowledge that the resources necessary to provide for the demands of higher education were becoming increasingly limited; yet, there had been a national average annual increase in the expenditures on computing activities in higher education of 42% from FY63 to FY68.[1] Little knowledge existed about the Illinois situation since no review process of these expenditures existed for the colleges and universities.

As with all major Board planning projects, a study committee was appointed to consider the need and feasibility of computer network systems, and their attendant personnel and programming systems. The members of this committee were primarily from the upper management levels of public and private institutions, educational governing systems, government, and private industry. Their work served as an input to Master Plan-Phase III.

In May, 1971, the Board of Higher Education adopted this master plan. It called for the development of "recommendations to establish an integrated system of higher education, one statewide network, calling upon and utilizing to the fullest extent possible the resources of public and private colleges and universities." A complete chapter of this document was devoted to the development of a State computer network as an integral part of this integrated system of higher education. The following specific recommendations were made:

---

[1] R. E. Levien, etal, The Emerging Technology, Instructional Uses of the Computer in Higher Education, (Draft), September, 1970, p. 157.

.. Develop a plan, through appropriate committee involvement, for statewide computer resource coordination.

.. Address the needs for faculty training.

.. Identify areas for joint development of computer systems. The plan will recommend the most efficient ways to achieve joint development in these areas. Where joint development is not possible, the plan should specifically state the reasons.

.. Establish a Computer Equipment and Services Review Task Force to provide technical assistance to the Board of Higher Education staff in its review of proposals for expansion of computer equipment and services.

Institutional reaction to these recommendations was favorable (see Appendix A). At its June, 1971, meeting the Board of Higher Education pressed ahead with the project by calling for the development of the detailed plan by December, 1971, and adopting a policy calling for a moratorium on additional computer expenditures at the public institutions until such a plan was developed (see Appendix B).

State Government Planning

Concurrent with the Board of Higher Education activity was the interest of State government in the development of a plan for State uses of the computer that was directed to economy, optimum allocation of resources, and increased public service. This interest lead to the issuance by the Department of Finance, in April, 1971, of IMPACT 70's (The Illinois Master Plan Applying Computer Technology in the 1970's). This plan called for the State agencies to adopt a data management system using common computing equipment and a common data base. Higher education was included to the extent that it was conceived as part of the education data base, utilizing the educational data bank for its operational activities and providing information to other "common industries" (see Figure 1).

IMPACT 70's more specifically called upon higher education for the "establishment of liaison with degree granting institutions throughout the State to develop a uniform program leading to an associate, bachelor's, or master's degree." It was felt that such a program would provide the continuing education requirements of EDP personnel at the novice, specialist, and decision making levels.

As important as IMPACT 70's specific recommendations was the discussion relating to "centralization justification." This section of the report called for legislation to be introduced which would "centralize all computer activity in the State educational community."

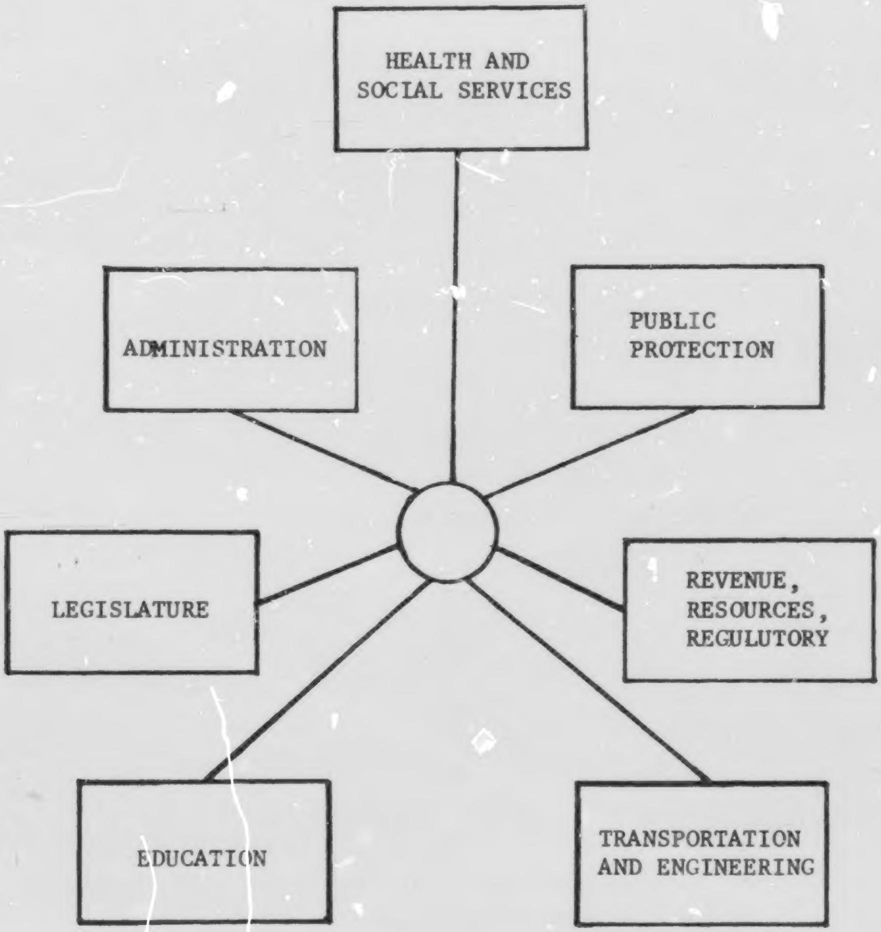
Legislative Actions

House Bill 2372 introduced during the 77th General Assembly by Representative R. Bruce Waddell would achieve the proposed centralization. The bill calls for the placement of all electronic data processing activities of the colleges and universities under the Department of Finance, Management Information Division. The bill was tabled in the House Executive Committee.

Also during the 1971 session of the 77th General Assembly, the House Appropriations Committee requested the Bureau of the Budget and the Department of Finance to provide staff assistance for an analysis of the institutional requests for funds for computing and data processing. A task force, chaired by Mr. John Gentile, Deputy Director, Department of Finance and staffed primarily from outside sources, was formed to study the university operations. They produced a report that has become known generally as the "Regner Report," named after the Chairman of the House Appropriations,

Figure 1

Proposed Illinois EDP System Architecture


HEALTH AND SOCIAL SERVICES
ADMINISTRATION
PUBLIC PROTECTION
LEGISLATURE
REVENUE, RESOURCES, REGULATORY
EDUCATION
TRANSPORTATION AND ENGINEERING

Representative David J. Regner. The specific Findings, Recommendations, and General Observations produced by this study are included as Appendix C. Generally, the task force found that:

.. The public senior universities had adequate computing facilities.

.. Guidelines for the acquisition of new computing equipment were generally lacking.

.. The average cost per student for administrative applications ($36) was more than twice the average instruction cost per student ($17), yet the administrative systems in many instances were archaic and in need of further development.

The task force concluded that there was no need for additional funding beyond the FY72 levels until such time as the issues raised by the study were resolved.

Plan Development

The staff of the Board of Higher Education proceeded with the development of the statewide plan by maximizing the institutional involvement in its creation. Because of its success on the national level, the WICHE-NCHEMS organizational model was chosen as a guide for the committee structure. All public and private higher educational institutions were invited to participate at one of the following levels:

Level 1. On mailing list for keeping track of progress, but would not attend meetings, submit data or commit technical representative(s) to help in plan development.

Level 2. On mailing list, attend meetings, but would not submit data or commit technical representative(s) for development.

Level 3. On mailing list, attend meetings, submit data, but would not commit technical development representative(s).

Level 4. Did all of above, plus commit technical representative(s) for assisting in plan development. It was anticipated that all public universities and colleges would want to participate at this level.

One hundred and six institutions of the State's one hundred and thirty-four institutions participated at one of the four levels (see Table 1 for a profile of participating institutions). Three committees were formed. The Steering Committee consisted of one member from each institution committed at Level 2 or above. The purpose of this committee was to act as a "sounding board" for ideas as the plan developed. The Technical Committee was formed to study the feasibility of the alternate plans as they were developed. The Policy Committee was formed to determine the policy implications of the alternate plans as they were developed. Technical subcommittees to define the needs in the instructional, research, and administrative areas were also formed.

Following several meetings of the Policy and Technical Committees it became apparent that within the time frame provided by the Board of Higher Education, it would, in fact, be impossible for a large group of people in committees to do the necessary staff work to provide a plan. Therefore, it was concluded at the August 4, 1971, meeting of the Policy Committee that the Board staff should be called upon to provide concentrated staff effort so that the necessary work could be done. To support the work of the staff, the Board of Higher Education and the Department of Finance engaged two consultants. A Planning Task Force consisting of these consultants, two members of the Board of Higher Education staff, and one member of the Department of Finance staff, was formed to work with the institutions in developing the plan. It was felt that the active joint involvement of the

TABLE 1

ANALYSIS OF ILLINOIS INSTITUTIONS INVITED TO PARTICIPATE IN THE STATEWIDE COMPUTING PLAN

CATEGORY	TOTAL NO. OF INSTS.	PARTICIPATING		NOT PARTICIPATING		PART. AT LEVEL IV	PART. AT LEVEL III	PART. AT LEVEL II	PART. AT LEVEL I
Public Senior Universities	13	(13)	100.0%		--	100%			
Public Junior Colleges	46	(39)	84.8%	(07)	15.2%	69.2%	20.5%	7.7%	2.6%
Private Senior Universities	9	(09)	100.0%		--	55.6%	33.3%	11.1%	--
Private Senior Colleges	37	(32)	86.5%	(05)	13.5%	9.4%	34.4%	21.8%	34.4%
Private Junior Colleges	11	(06)	54.5%	(05)	45.5%	16.7%	33.3%	--	50.0%
All Other Private Colleges	18	(07)	38.9%	(11)	61.1%	28.6%	14.2%	28.6%	28.6%

Total Number of Participating Institutions: 106

Of the 106 Participating Institutions, 12% are Public Senior Universities
37% are Public Junior Colleges
8% are Private Senior Universities
30% are Private Senior Colleges
6% are Private Junior Colleges
7% are All Other Private Colleges

institutions, the Board of Higher Education, and the Department of Finance would likely assure the development and acceptance of the plan.

Also assisting, indirectly, with the development of the statewide plan was the consulting firm of Morrison and Rooney Associates, Ltd. This firm was employed by the Board of Higher Education and the Department of Finance to aid in evaluating the FY73 institutional budget requests in the computer area. This assistance had been called for in the Regner Report, in Master Plan-Phase III, and at the June, 1971, meeting of the Board of Higher Education. At that meeting the development of an interim procedure for review of computer operations during the development of the statewide plan was approved. It was stated that the procedure should involve the following elements:

- .. A policy specifying what types of computing activities will be allowed to expand during the development of the statewide plan.
- .. The procedures to be followed and data to be submitted in support of a request for computer services expansion.
- .. The establishment of an impartial Review Commission to review institutional applications for expanded computer resources.
- .. Provision for private institutions to utilize the procedure if they so desire.

Morrison and Rooney Associates, Ltd. performed audits of the major computer installations at the following shcools:

1. University of Illinois-Chicago Circle
2. University of Illinois-Medical Center
3. Cooperative Computer Center at Chicago State University
4. Chicago State University
5. Northeastern Illinois University
6. Eastern Illinois University
7. Western Illinois University

8. Illinois State University
9. Northern Illinois University
10. Southern Illinois University at Carbondale
11. Southern Illinois University at Edwardsville

Governors State and Sangamon State Universities do not have computers and hence, were not audited. The University of Illinois-Champaign/Urbana was not audited because of the lack of time to do an adequate job.

These audits and identifying all EDP costs for all State supported centers at each public senior institution enabled the Board staff to make FY73 budget recommendations which reduced computer center expenditures by 3.5 million dollars and provided data to the Planning Task Force for long range planning.

The Planning Task Force synthesized these and other data and prepared a document entitled "The Statewide Plan for Computer Resources in Illinois Higher Education" (see Appendix D). This document made recommendations for a computer network and sharing to be effected through a new organization form. Three major recommendations were made in this regard. These were:

.. A public-interest corporation, created by the public senior institutions, is the best organization form for network operations.

.. The community colleges and private colleges and universities would participate in such a network on a voluntary basis after its initial implementation in the public senior institutions; the economic mechanism of the network will prove attractive enough to encourage participation, and provide the community colleges and private institutions with the richness of services and low costs available to the public senior institutions.

.. Equipment purchases, with long term funding and amortization cycles, would permit marked reductions in both cost and immediate cash flow.

Broad general areas were also proposed for implementation under the new organizational form. These were:

.. Implementation of a network so that a wide range of interactive languages, remote instructional and research computing services, and administrative systems are available equally to all institutions within the State.

.. Implementation of a data base management system for institutions of higher education as a method of reducing data storage and retrieval costs, and to significantly reduce the maintenance cost of administration applications.

.. Improved allocation of computer resources so that there are appropriate mixes of skilled personnel, equipment, and service access to meet computer service demands.

.. Cooperative development of administrative applications.

After review of the document, the Policy Committee on November 23, 1971, passed the following motion: "The Policy Committee endorses the Task Force report, but refers the consideration on the formation of the public-interest corporation to the appropriate level of management of the institutions and the system heads."

On December 6, 1971, the Joint Council on Higher Education, which includes the presidents of all public universities, formed a committee to investigate the details of the public-interest corporation. This committee issued a report (see Appendix E) which:

.. strongly endorsed the general objectives underlying the Task Force's plan for cooperation in the provision of computer services;

.. agreed that the major initial impetus for such a cooperative effort should come from the public senior institutions;

.. agreed to cooperate in determining the feasibility of a public-interest corporation;

.. established a voluntary consortium, the Illinois Universities Consortium for Computer Services, of public senior institutions to proceed towards the major objectives of the Task Force's report;

.. established two institutional task forces; one on Organization and Mission, and the second on Inter-institution Cooperation in Computer Services;

.. adopted the following schedule:

January 15, 1972 - Initial consortium meeting

March 7, 1972 - Report to Board of Higher Education concerning proposals for organizational form

July 1, 1972 - Complete organizational arrangements

September 30, 1972 - Initiate pilot programs for inter-institutional cooperation

September 30, 1972 - Evaluation of progress by Board of Higher Education Task Force - Department of Finance Task Force

Prospectus

The following pages are offered by the Task Force to the Board of Higher Education, the Department of Finance, and the Illinois Universities' Consortium for Computer Services for their use in better applying computer resources to the higher educational process. The Task Force feels that its recommendations represent a plan that will succeed in producing benefits to higher education. Plans, however, are not self-implementing nor self-imposed. A statewide plan for higher educational computing resources can only be implemented by a cooperative effort of the higher educational community or by the legislative process. It is hoped that the ideas presented herein will have an impact on the implementation of such a plan.

CHAPTER II

PROCEDURE

General Approach

The development of this report has involved the active participation and contributions of the private and public educational community, both in and out-of-state. Appendix F shows a calendar of meetings held as part of this study. In addition to these meetings, there were numerous private discussions between members of the Task Force, institutional personnel, and others.

In all cases the Task Force tried to adhere to the following principles:

.. Detailed discussions of alternatives at the staff level.

.. Presentation of the detailed results of studies to the top level administrator involved.

.. Recommendation of the preferred alternative with the supporting rationale to the top level administrators.

Data to support this report was collected from many sources. Several questionnaires were utilized in an attempt to collect information from the participating institutions. By and large, the Task Force feels that this approach was the least effective. Interpretation of the questions by the respondents caused unexplainable variations in the data captured.

A much more productive approach was that used as part of the review procedure for the FY73 operating budgets. Each public university was asked to submit a line item budget for their major computer installation. Review of these budgets was enhanced by an audit of each university's computer center to determine its utilization. The general approach was to conduct interviews with both computer center and user personnel prior to the document analysis of the computer center operations. Of all the data produced by this study, the Task Force feels that this data is the most reliable and would recommend this approach over the questionnaire approach to any others about to undertake such a study.

The result of this approach is that the "hard" data included in this report comes almost entirely from the public university sector. While the junior colleges receive funding from both the State and local levels, there control is at the local level. Therefore, there is no way in which cooperation in providing data can be enforced. The private institutions being completely independent from State regulation are obviously in the same situation.

It should be recognized, however, that the realities of this situation have had a real impact on the proposals developed by the Task Force. There has been a conscious recognition of the traditional autonomy of the institutions in the proposal for a public-interest corporation to be controlled by the institutions and to provide services that can be economically beneficial to the institutions.

Another source of input to this report was the reports of the subcommittees on instruction, research, and administration. These reports, together with a position paper submitted by directors of data processing in the community colleges are available, upon request, from the Illinois Board of Higher Education.

The Task Force's concern for the statewide plan for computer resources to be responsive to student needs led them to interactions with the Student Advisory Committee to the Illinois Board of Higher Education. The two meetings with this group confirmed that there is neither a widespread use of the computer in instruction nor an appreciation of its value.

The Task Force firmly believes that due in part to past misconceptions and misapplications of the computer, most top level educational administrators are unaware of the benefits that proper application of the computer can bring to educational and administrative processes. On the other hand, the Task Force is convinced that without top level commitment and strong involvement, a plan to insure such applications will never be developed and implemented. Therefore, every effort was made to contact these administrators.

Discussions were held with every president, chancellor, and system head in the public university system, and a document entitled "The Statewide Plan for Computer Resources in Illinois Education" (see Appendix D) was presented to the Joint Council on Higher Education. Meetings were held with the Association of Illinois Junior College Presidents and the Illinois Community College Trustees Association, at which papers (Appendix G) were presented. A paper (Appendix H) was also presented at a meeting of the Federation of Independent Illinois Colleges and Universities. The "Statewide Plan for Computer Resources in Illinois Education" (Appendix D) was also distributed to these colleges.

The results have been gratifying. A University Consortium for Computer Services has been formed under the auspices of the Joint Council on Higher Education to investigate the organizational forms and implementation requirements for a coordinated State plan.

The junior colleges are favorably disposed to voluntary participation in such a plan. The mechanisms proposed by the Task Force give the junior colleges the opportunity to evaluate and take advantage of the economics that are expected. Both of the junior college associations contacted passed motions which expressed a desire to be represented on the Board of Directors of the proposed public-interest corporation.

The private colleges and universities have also been receptive to the plans proposed by the Task Force. In an independent survey conducted by the Very Reverend John R. Cortelyou, President of DePaul University, the institutions have indicated that the policies presented by the Task Force seemed reasonably acceptable and that they would benefit private higher education (see Appendix I). Twenty-seven of the thirty-two institutions contacted felt that the Federation of Independent Illinois Colleges and Universities should lend its support to the adoption of these policies.

Task Force Members

The following five individuals formed the Task Force for Statewide Computer Plan Development, and are responsible as a group for the interpretations and recommendations contained in this report.

Messrs. David F. Nyman and Gary L. Bemiller, staff members of the Illinois Board of Higher Education, were the principal authors of this report. Mr. Nyman has twelve years experience in the data processing field including four in industry, five as a professor of systems analysis, and three in higher educational planning. Mr. Bemiller has ten years experience in the data processing field including five years in corporate and educational planning.

Mr. John L. Gentile, Deputy Director, Department of Finance, was the third member of the Task Force. Mr. Gentile served as the State's project director and overall coordinator in the preparation of IMPACT 70's. He has had experience with data processing in industry and the Federal Government. He also serves on numerous commissions and boards, and is the president-elect of National Association for State Information Systems (NASIS).

Dr. Rocco L. Martino and Mr. James Farmer acted as working consultants to the project. Dr. Martino's background includes over two decades of involvement in the data processing field. In addition to thirteen books on management information systems, data processing, and computer science, he is the principal author of IMPACT 70's. Mr. Farmer has been a Rand Corporation consultant, a computer center director, and is currently a staff member of Systems Research Incorporated (of Oklahoma). He was principally responsible for the development of the computer network for the California State College System and is an active contributor to the WICHE-NCHEMS program.

The Task Force would like to thank the members of the Illinois higher educational community for their assistance in the development of this report. Many long voluntary hours were spent by these people in sharpening the issues and resolving approaches to a statewide plan.

CHAPTER III

SUMMARY OF FINDINGS AND RECOMMENDATIONS

SUMMARY OF FINDINGS

A. General

1. There is no mechanism for coordination or control of computer expenditures and decisions in institutions, in governing systems or statewide.
2. There is a latent demand for computing services, but adequate software and training appear to be inhibiting the satisfaction of that demand.
3. Users are concerned about a demonstrated level of service both on campus and for any proposed remote service.
4. Management of computing resources has not been oriented toward satisfying user needs.
5. There are no statewide standards for development, management, and use of computer systems.

B. Administration

1. It is doubtful that any single institution has available all the resources required to produce the administrative systems that each of them need. On the other hand, all of the institutions together have more than enough resources, and collectively, they have been spending more than enough funds up to now, to develop all of the administrative systems that they require.
2. More than half of the computer related expenditures are directed to administrative functions. Despite this major thrust

of expenditures,

- .. There is no uniform financial management system.
- .. The majority of institutions produce no analytic studies by computer.
- .. There is a serious hardware overcapacity that approaches 50% of the total complement of hardware.

3. Budgets are becoming increasingly tight. Yet in Illinois public senior institutions, the cost per student has been increasing at a rate greater than the inflationary effect and as rapidly as the national average. Further, the administrative percentage of the budget and the cost of administration increased more rapidly than all other costs.

C. Instruction

1. Computers are becoming a larger and larger part of our daily lives in general, and in education in particular. By 1980, it is estimated that 90% of the students in higher education will encounter the computer either as an instructional device or as part of a course using computers. Despite this,

   - .. There is no statewide program to train teachers about computers.
   - .. There is a shortage of terminals for student use.
   - .. There is little effort to acquaint students about the existence and capacity of computers.
   - .. There is little or no effort to institute a program of orientation for the general public.
   - .. There is a tendency to develop all computer instructional materials uniquely at each campus rather than use materials developed elsewhere.

2. There exists a fierce pride about an institution's existing computer configuration as a symbol, making it almost

impossible to discuss consolidation even though it may enhance institutional capability.

3. Faculties typically point to all the work they are doing on computers and all the increased volumes of work that can be expected in the future. Several computer configurations have been partially justified on such predictions. Yet, workload analysis indicates that these volumes of work have simply not materialized. Comparatively speaking, the only widespread penetration of the instructional process in the State public senior institutions has occurred at the University of Illinois at Urbana.

D. Research

1. Within the university environment, research contracts are negotiated between the principal investigator at the university and the program officer at the granting agency. Little institutional control or coordination has been exercised over how the principal investigator obtains his computing power for the purposes of the study.
2. There are serious problems with the way Federal funding formulae have been applied to the support of research computing on the institution's general purpose computer.
3. The Urbana campus of the University of Illinois accounts for 87% of the research computing for the State's public senior universities.

E. Computer Assisted Instruction

1. Most attempts at computer assisted instruction to date have

been unsuccessful. The overwhelming reason for this failure has been the unfavorable comparison of the cost of this method of teaching to the more conventional methods. This has arisen from the scale of implementation that has been attempted in the past.

2. The PLATO IV system under development at the University of Illinois appears to have overcome these cost difficulties while presenting the most sophisticated approach to date.
3. There is a need to test the effectiveness of this approach to education in comparison to the more conventional methods of instruction.

F. Public Junior Colleges

1. The junior colleges have a split area of control since their funding comes from the State and local levels. Consequently, there is very little control that can be exercised upon computer expenditures. There is no way in which cooperation can be forced through regulation. Cooperation with a statewide plan must come through the economic mechanism, i.e., better service at a lower cost than is now available.
2. The junior colleges are favorably inclined to the concept of the economic mechanism proposed as part of a public-interest corporation. The Illinois Community College Trustees Association passed a motion requesting "... representation on the proposed Public Corporation for Computers in Education Board of Directors," after the concept was presented to them. The Association of Illinois Junior College Presidents passed a

similar motion requesting that two public junior college representatives be on such a board.

G. Private Colleges

1. The private institutions being completely independent from State regulation must also be attracted to a statewide plan via the economic mechanism. Individual member institutions of the Federation of Independent Illinois Colleges and Universities have given their support to the concept of a public-interest corporation to provide the mechanism for this concept. Twenty-seven of the thirty-two institutions have indicated that the Federation should support the concept.

2. The characteristics that make the corporation desirable to the private institutions are:

   .. A free choice of the type of services to be utilized on the part of each institution.

   .. An economic mechanism for the distribution of services.

   .. Possible attainment of costs of service that are less than, or competitive with, commercial service.

   .. The mechansim for the development priorities to be user oriented.

   .. The opportunity for the participation of the private institutions in policy making decisions and implementation design.

SUMMARY OF RECOMMENDATIONS

A. Cooperation

1. The consortium, after thorough investigation, should adopt and

form a public-interest corporation as the organizational body to:

- Own, staff, and operate a network of computer equipment in higher education.
- Provide the processing services necessary to satisfy higher education's demands.
- Ascertain the administrative and instructional systems which are capable of central development and assume the responsibility for that development.

2. PLATO IV development should remain under the direction of the University of Illinois as long as the system is in the research and development phases. However, at the conclusion of the proposed demonstration project (in approximately three years), the Board of Higher Education must be in a position to make recommendations regarding the statewide implementation of this system. To do this, the Board must be able to evaluate the cost and effectiveness of the system. Therefore, it is recommended that the Board staff be directed to investigate the developmental procedure proposed by the University of Illinois to determine if it will provide adequate information for such recommendations. Should a decision be made to implement the PLATO system in the State higher educational system, that implementation should be carried out by the public-interest corporation.

B. Implementation

The following time cycles are recommended for the implementation of a public-interest corporation:

- A one year cycle, ending June 30, 1973, during which the mission, structure, and organizational approach for the public-interest corporation will be established. During that time, interinstitutional services should be provided on a contract basis.

.. A two year period ending June 30, 1974, during which moves would be completed to establish the corporation's direct control and responsibility for staffing and operations.

.. A review and commitment by June 30, 1974, for the corporation to be operative until at least 1980, with a contractual guarantee of the procedures and services to be delivered by the corporation to the institutions during that period.

C. Control

The public institutions should follow the established budgetary procedures in seeking State appropriations for their computing activities. Further, it is recommended that at least the following approach be followed:

.. The establishment of computer center line item budgets for all EDP expenditures within the institution.

.. The institutional control of its expenditures according to this budgeted amount.

.. The development and implementation of institutional charge-back accounting systems requiring each departmental user to budget and pay for the computer services it uses.

.. Institutional performance audits of the computer center should be continued under the auspices of the Board of Higher Education to determine the effectiveness of the institutional expenditures.

.. Appropriation recommendations should be made by the Board of Higher Education based upon the results of the audit.

D. Priorities

1. A detailed development of a services implementation plan should be the top priority of the public-interest corporation. It is

recommended to the corporation that the broad outline suggested below be followed:

.. Implementation of a network service to provide instructional time-sharing by January 1, 1973.

.. Implementation of a network service to provide remote batch processing for instructional purposes by June 30, 1973.

.. Implementation of a network service to support the general class of computing where the computer is used as an instructional problem solving tool, by June 30, 1974.

.. The immediate embarkation of an interinstitutional development project for administrative systems, pointing to the implementation of initial systems not later than June 30, 1974.

.. The establishment of the University of Illinois at Urbana as the site for the operation center for the network activities during FY73.

.. The establishment of other operation centers as the workload and cost effectiveness demonstrate their need.

2. It is recommended to the corporation that the services implementation plan include:

.. A definition of workloads that are to be processed on campus, and the workloads to be processed via a network.

.. A definition of the applications to be developed centrally and those to be developed locally.

.. A specification of the hardware configuration, and staff size and type that is to be resident on each campus, based upon the above considerations.

.. A specific time-table of services to be offered and the applications to be developed.

3. It is recommended that the following be immediately addressed and implemented:

.. The establishment of a single contact at the institutional, State, and vendor levels, who has the responsibility for all decisions regarding computers for his constituency.

.. The establishment of a central information clearing house at the State level to provide information on vendors, the technical characteristics, cost, and availability of hardware, software, and other computing services within the State, and training and conferences.

.. The establishment of a procurement procedure which assures that the equipment and services of individual vendors, combinations of vendors, and quantity discounts are considered relative to vendor dependence, service capability, and financial stability.

.. The investigation of statewide leasing of computer equipment funded through the issuance of bonds, the establishment of long-term loans, or legislative appropriations.

.. The adoption of a policy regarding the justification of Dedicated Computer Facilities (DCF), such that these facilities are justified based upon the enhancement of the research project only.

.. The integration of other universities into the ARPA network through the University of Illinois, in those specific situations where the research at these institutions warrants such a connection.

.. The development of specific programming, telecommunications, and documentation standards for statewide exchange.

.. Cooperation with State government for the investigation and development of user oriented data management systems for statewide adoption.

.. The establishment of cost justification procedures relative to institutional decisions for the development of administrative systems.

.. The development of training programs for faculty and staff.

CHAPTER IV

BASIS FOR RECOMMENDATIONS

Introduction

Illinois is a leader in higher education. Such leadership can only be be maintained by responding positively to changing needs in a changing environment. Of particular interest today are the academic and public concern with:

.. individual identity,

.. autonomy of the institutions,

.. financial crises,

.. philosophic conflict between individual freedom and the rights of a society group, and

.. student demand for innovative educational delivery systems.

Within this broader domain of concern in higher education lies the computer -- its use, place, and potential impact on education, the public interest, and institutional structure.

In computers, too, Illinois has a long history of leadership and accomplishment. In particular, the accomplishments of the University of Illinois with ILLIAC and PLATO have brought world renown to the State. Several other Illinois institutions representing all systems of higher education have received national recognition for particular applications -- especially in the admissions and records, library, and vocational education areas.

The problem, then, is one of examination of present programs and of current organization of the total computer effort, with a view to setting longer term goals within the environment of the total needs of higher education.

Such a change is required because the computer too has changed since its inception twenty-six years ago. In the early days of its use, as a laboratory curiosity, the computer was the province of the specialist. Now, as a proven device, the computer is a large and accelerating component in our economy, and our way of life. The computer at higher educational institutions has taken on the added dimension of a production device for instruction, research, and administration as well as being the subject of research and instruction.

One aspect of computers, however, has remained from the earliest days; and that is their cost, and the cost associated with using them. Several studies on computer costs, and the ancillary costs associated with them, have produced a number of rules of thumb. These are essentially as follows:

1. The cost per unit of work decreases in moving to the larger scale systems.[1]
2. The cost of the hardware is decreasing as a percentage of the total cost of computing systems. Yet, most of the attention in computer selection and computer planning is devoted to the hardware.
3. Total costs in any given installation appear to be three to five times the equivalent purchase cost of the computer. The five components are:
    - (a) the equivalent purchase price,

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[1] See William F. Sharpe, "The Economics of Computers," pp. 314-322 and A. E. Oldenhoeft and M. H. Halstead, "Maximizing Computer Power and Cost Factors in the Centralization Problem," Communications of the ACM, March, 1972, for a technical discussion of this point.

(b) the cost of programming and maintaining the system,

(c) the cost of operating the system,

(d) the cost of data collection and report preparation, and

(e) management involvement.

4. Whether a system is purchased or leased, due to continual upgrades of the computer system, the expected "life" of a typical system appears to be about four years.

5. The costs of software development are steadily increasing, as personnel costs become a larger proportion of the total cost. On the other hand, software development is becoming much more complex, as the hardware itself becomes more sophisticated. The result is serious delay whenever attempts are made to develop dedicated application-type software.

6. A significant trend in computer development is directed towards systems linking a number of computers, with large scale power at some central point, through a communications network operating with a series of terminals at user locations. The advantages to remote users achieved by this approach are:

   (a) the availability of a large computer which provides speed and storage capability which might be unavailable locally,

   (b) the support of large data files and data banks which might be impossible locally,

   (c) the support of a wider range of programming languages than might be possible locally,

   (d) the possibility of the sharing of a program library among all users, and

   (e) cost reductions due to economies of scale available on the larger remote computer.

7. The combination of large scale on-line storage and the modern data management system software languages now makes it possible to develop data banks which provide all the flexibility required by individual users, while eliminating redundancy, error, and organizational complexity.

Because of these developments, and because of the far ranging impact of computer applications not only in higher education, but in our everyday life, decisions concerning computers and computer use must be the concern of the highest decision-making level in higher education. This is so for the following major reasons:

1. Since the domain of applications is broader, there are inter-departmental and interdisciplinary aspects of the decisions.
2. The major decisions are no longer technical, but mainly those of policy, budget, and the law.
3. Costs are high now, but accelerating; total computer costs in Illinois higher education have increased at 19% per year during the last three years, and 33% per year during the period of 1965-1970. The projections for computer use to 1980 will require investments in the hundreds of millions of dollars to meet the requirements at that time.
4. The problems associated with computer use are directly related to the problems of the day; and these include privacy, the security of data, personalization or the lack of it, public service, and the need to increase productivity and quality in education.

This study was instituted with the objective of developing a long-range plan for the use of computers in higher education in the State of Illinois. No plan has any value unless it is directed towards the environment of the day. Long-range planning is definitely based on the futurity of present decisions. Such decisions are made with the best possible knowledge in order to minimize the risk of these decisions. Following these commitments, it is vital that the efforts required to implement the decisions be organized systematically. And the final requirement is that the results be measured continuously through an organized and effective systematic feedback approach continually comparing the projected impact of the decisions made with their true impact.

In order to apply this concept to the task at hand -- a long-range plan for computer use in higher education for the State of Illinois -- it is necessary to make every attempt to establish the best possible knowledge of the past, present, and future environment in higher education in general, and computing services in particular.

Higher Education Environment

Higher education today is in a ferment of cross currents associated with various concepts, theories, and approaches to reform, innovation, and renaissance. A detailed examination of this problem is beyond the scope of this report. It is vital and necessary, however, to be cognizant of the probable developments in higher education to 1980 because decisions about computers will be affected by these developments.

It is likely that the demand for higher education in Illinois will increase until 1980.[2] More important, though, are the changes expected in the mix of the clientele served by higher education, and the program priorities to be addressed by higher education. The demands for new emphasis on continuing education, community service, the training of "doers rather than researchers," and for new institutional, organization, program, departmental, and course structures will all affect the way in which computers serve the campuses.

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[2] "A Master Plan-Phase III, for Higher Education in Illinois," pp. 29-33.

It is further recognized that there is an urgent need for greater personalization in higher education. To many, the expanded use of computer systems may appear to be the antithesis to satisfaction of this need. It has been a common experience for many to feel that they have been molded to fit the computer's needs rather than having the computer serve their needs. The more sophisticated explanation of this dehumanization has revolved around the "necessity" for a high degree of standardization for efficient operation of the computer. The more pedestrian argument has been the personification of the computer, e.g., "the computer overcharged your account." Neither of these arguments are valid. The power of today's computers make a mockery of the efficiency argument and, of course, the computer alone can do nothing. It requires people with foresight and vision to design administrative and instructional systems that are easy to use, forgiving of mistakes, clear, unambiguous, and natural. Attention to these features will provide computerized systems that will enhance the future personalization of higher education.

The demand for privacy will increase and the responsibility for the institutions of higher education to insure security of data will be essential. Institutions, governing boards, coordinating boards, and legislative bodies have collected and used data about institutions for many years, but never with the degree of completeness and potential of access made possible by computing and communications equipment. Whatever system is utilized in higher education, there must be guarantees, and there must be realistic examinations and approaches to the question of security of data, privacy of the individual, and the rights of the individual and the institution in checking the data concerning them to insure that it is accurate, and being used properly.

Historical Demand for Computing Funds in Illinois

The Regner report established the fact that the State government is both interested and concerned about the use of State funds in support of computing in Illinois higher education. While the report contained the first definitive information describing each institution's computing activities, it made no recommendations that specifically affected the institutions computing budgets. It did, however, point out several problem areas which the Task Force concentrated on, one of which was a detailed line item budget review performed by the Board of Higher Education staff to assist in evaluating computing funding proposals during the FY73 operating budget cycle. This yielded much valuable cost and utilization information which is discussed below.

Computing Funds. It is interesting to note the manner in which computing expenditures have grown at the universities. Table 2 shows total computer expenditures as summarized from Annual Reports (excluding the University of Illinois which does not break out computing expenditures):

TABLE 2

Computing Expenditures at Illinois Public Universities
(Excluding U. of I.)
1965 - 1970

YEAR	AMOUNT	% INCREASE OVER 1965
1965	$1,580,000	--
1966	2,470,000	56
1967	2,721,000	72
1968	3,976,000	151
1969	5,314,000	236
1970	6,678,000	322

Table 2 shows that these expenditures have increased 322% in the five year period or a compound annual growth rate of 33.4% per year. The Regner report provides more recent data on the growth of computing expenditures. The time period reported was FY70 through FY72. FY72 was reported as an estimate based on projected needs. An analysis of this cost data is presented in Table 3.

TABLE 3

Computing Expenditures At Illinois Public Universities
As Summarized From The Regner Report
FY70 to FY72
(in 000's)

YEAR	PERSONAL SERVICES	CONTRACTUAL SERVICES			ALL OTHER EXPENSES	TOTAL EXPENSES
		COMPUTERS	OTHER	TOTAL		
FY70	5056	4689	231	4920	803	10779
FY71	6800	5758	244	6002	907	13709
FY72 (est.)	7487	6608	356	6964	1051	15502
70-72 pct. change	48%	41%	54%	42%	31%	44%
Pct. of Total	48.4%	42.6%	2.1%	44.7%	6.9%	100.0%

This table shows that for the three year period analyzed, total computing expenses increased by 44%, with increases in personal services of 48%, and in the computer expense portion of contractual services of 41%. In total, this represents an average annual compound growth rate of 19.9%.

Total Higher Education Funds. By way of contrast, it is possible to compare the growth rates in computing that occurred between 1965-1970 to the growth rates of total higher education enrollment and expenditures during the same period. These data are taken from the year end Annual Reports of each university as prepared by independent auditors, on file with the Auditor General. An analysis of this data, as displayed in Table 4, shows the following:

1. Enrollment increased 83% during the period, or at an annual rate of 12.9% per year.

2. Total expenditures increased 123% during the period for an annual growth rate of 17.5% per year.

3. While total expenditures were expanding rapidly, certain types of expenditures experienced an even greater growth:

    (a) administrative expenditures grew at the rate of 22.5% per year, and

    (b) instructional expenditures grew at the rate of 18.7% per year.

TABLE 4

Total Expenditures At Illinois Public Universities
Annual Compound Rate of Growth*
FY65 to FY70
(in 000's of dollars)

BUDGETARY ACTIVITY	EXPENDITURES		RATE OF GROWTH
	FY65	FY70	
Administration	$ 24033	$ 66371	22.5%
Instruction	78567	184677	18.7%
Research	35827	67106	13.4%
Public Service	15076	22197	8.0%
Other Education & General	45293	96622	16.4%
Total Education & General	198796	436973	17.1%
Other Non-Education & General	38327	94007	19.7%
Total Expenditures	$237123	$530980	17.5%
Enrollments	84965	155490	12.9%

$$^{*}\text{Growth Rate} = \sqrt[5]{\frac{FY70}{FY65}} - 1$$

While more recent audited data is not yet available, information from other sources give an indication that these growth rates have leveled off. Table 5 is a summary of higher education operating expenditures developed by Board of Higher Education and Bureau of the Budget staff using the Department of Finance Annual Report as a source.

TABLE 5

Operating Expenditures Per Student At Illinois Public Universities

	1963 - 1972			
YEAR	OPERATING EXPENDITURE*	ON CAMPUS ENROLLMENT	EXPENDITURE PER STUDENT	% INCREASE IN EXPENDITURES PER STUDENT
1963	$119.8	69698	$1721	
1964	129.3	76831	1683	- 2.0%
1965	154.1	84965	1814	+ 7.7%
1966	182.2	98189	1856	+ 2.3%
1967	213.8	107419	1990	+ 7.2%
1968	234.9	116582	2015	+ 1.2%
1969	288.4	131119	2199	+ 9.1%
1970	341.2	143285	2381	+ 8.3%
1971	404.9	156249	2591	+ 8.8%
1972 (est.)	406.9	168378	2415	- 6.8%

* in millions

Table 5 shows that even while absolute expenditures for higher education operations continue to grow, there is evidence that the cost per student fell in 1972 for the first time in a decade. And this is not unexpected considering recent priorities in State government funding and the State's and nation's economic outlook.

It is difficult at best to attempt to compare the cost per student in Illinois as compared to similar national statistics because of the wide and divergent ways in which data is accumulated and reported. The data in Table 5, however, seem to indicate that the expenditures per student (operations only) in Illinois have grown in roughly the same proportion as reported national averages (7 to 10% per year dependent on the source cited). A widely accepted figure is 7.5% per year, as stated by Dr. William G. Bowen, President, Princeton University. The "worst case" in

Illinois (1964 to 1971) shows an average annual compound growth rate of 7.4%. And, because of fiscal restraint during FY72, the cost per student shows a net decrease.

While this cost reduction resulted from the leveling off of the growth of State appropriations as student enrollment grew at higher rates, there still is a concern that something can and must be done to bring costs down even further through cost-conscious management practices. The objective is to increase productivity and to reduce costs. Through reduction in costs, it would appear realistic to aim at the reduction of absolute dollars and appropriations. But, perhaps a much more realistic and attainable objective is to make every attempt to reduce the rate of increase of expenditures per student. One way which has only recently caught the eye of higher education planners and members of the General Assembly, is the consolidation and sharing of educational resources as more thoroughly covered in Master Plan-Phase III. Specifically relating to the problem at hand is the statewide consolidation of higher education computing resources.

Finally, Table 6 below summarizes the trend regarding state appropriations to higher education.

TABLE 6

Appropriations To General Revenue And Income Funds At
Illinois Public Universities
FY58 to FY72
(in millions)

YEAR(S)	APPROPRIATIONS	PERCENT INCREASE (over previous years)
70th Biennium (FY58 & FY59)	$197.7	
71st Biennium (FY60 & FY61)	234.6	18.6
72nd Biennium (FY62 & FY63)	257.0	9.5
73rd Biennium (FY64 & FY65)	326.5	27.0
74th Biennium (FY66 & FY67)	498.6	52.8
75th Biennium (FY68 & FY69)	798.6	60.2
FY70	569.1	
FY71	636.4	11.8
FY72	651.3	2.3
% Increase - 70 to 75th Biennium		303.9
% Increase FY70 to FY72		14.4

It is seen that the State has had a large and continuing commitment to higher education as witnessed by:

.. Over a 300% increase in appropriations (a 32.6% compound biennial growth rate) from the 70th to the 75th biennium which is much greater than the general increase in enrollments and the inflationary factor during those years.

.. The continuation of the appropriations commitment from FY70 to FY72, but with increases at a much slower pace than previous years (3.8% compound annual growth rate).

It can be expected that the trend established between FY70 and FY72 will continue through the decade of the 70's. Funds simply will not be available in the large doses that have previously been forthcoming and will more nearly reflect increases in the prevailing inflationary rate. This impact will become very important to those persons at each institution charged with the on-going responsibility for providing responsive computer service to local users.

Analysis. State appropriations to Illinois higher education are continuing to increase although at a much reduced pace when compared to the decade of the 60's. While it is difficult to accurately predict for such a long period, it is not expected that funding during the decade of the 70's will much exceed the inflationary rate. Twenty-four of the fifty state legislatures in the nation appropriated no more than inflationary increases to higher education during the last fiscal year.[3] The only two possibilities seen for relieving this situation are a marked improvement in the welfare situation or "block grants" from the Federal government. And then, it is questionable whether State governments will treat block grants as additions above State support or a replacement for a portion of it.

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[3] As reported by Dr. Ernest Boyer, Chancellor, State University of New York, in a speech to the National Forum on New Planning and Management Practices in Higher Education, Denver, Colorado, January 26, 1972.

In the face of decreases in the growth of State appropriations, Illinois higher education is still experiencing a higher growth rate in computer expenditures than in total educational expenditures. There appear to be at least three reasons for this. First, expenditures on computers have grown from virtually zero to the present value, yielding a sizable rate of growth picture. Further, the computer is no longer in the province of the researcher alone. In the '60's, demand for graduates with some exposure to computers lead to the development of courses utilizing the computer. And finally, administrative systems have been computerized.

A pertinent question is whether computer expenditures will continue to grow. The average annual compound rate of increase in computer expenditures dropped to 19% in the period FY70 to FY72, as compared to 33% in the earlier period. Is the problem over? The Task Force does not believe that it is. Although there was some application of computers in the instructional process during the '60's, it was nowhere near what it should be, and thus, there should be increasing demands for fund to support such applications in the seventies. Administrative systems though computerized in the sixties, are not responsive to user needs and, therefore, new systems will be designed in the seventies. Finally, it is suspected that most private institutions and to a great extent, the public junior colleges in Illinois, have not experienced growth rates comparable to the public universities. There will be pressures on these institutions to "catch-up" in the seventies.

In face of this anticipated demand for computer services, the question becomes, "How can we control the growth of computer expenditures and effectively apply the resource to help solve higher education's problems?" The Task Force feels that the consolidation of computer resources in the State higher education system will help provide the answer to that question.

Current Demand For Computing Funds In Illinois

Funds Demand. It is estimated that the public university system is spending $14,317,000 for computer resources in FY72, as reported to the Board of Higher Education during the FY73 operating budget cycle. This represents "out-of-pocket" costs for the major university computing centers. It does not include additional expenditures by outside user departments that may have computing equipment and personnel, nor does it include the costs of Dedicated Computing Facilities (DCF).[4] Further, an accurate estimate of the total dollar figure for available computer resources should include an annual depreciation cost for purchased computers. Since these computers have been acquired in numerous ways, e.g., outright gifts, government grants, etc., it is difficult to agree on an acceptable method for costing these resources. Therefore, analysis has been largely restricted to the $14.3 million in out-of-pocket expenditures. A percentage breakdown of these expenditures, by system, is shown in Figure 2.

While the University of Illinois' share appears to be abnormally large, it is because all University of Illinois campuses are combined in the total. Following are the University of Illinois' computing expenditures (excluding DCF's) by campus as a percent of the total:

Urbana/Champaign	$3.972 million	(27.7%)
Chicago Circle Campus	$1.742 million	(12.2%)
Medical Center Campus	$1.465 million	(10.2%)
	Total	(50.1%)

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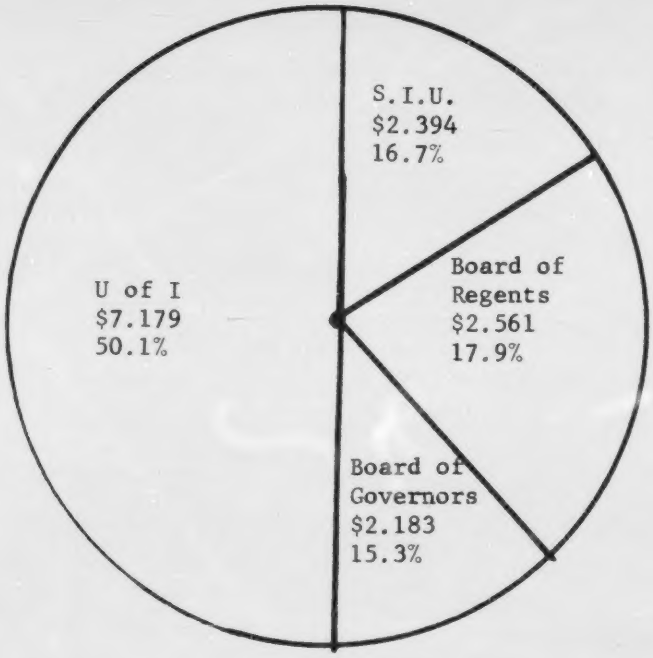
[4] THe "Report of the Computer Based Resources Advisory Committee" to the Board of Higher Education in December, 1970, identified a total of 68 computers in the public university system. Of these, 29 were purchased.

Figure 2

% Distribution of FY72 Operating Computing Expenditures by System (in millions)



Line Item Distribution. Table 7 is a summary of FY72 expenditures by line item which shows the following percentage breakdown:

TABLE 7

Line Item Distribution Of FY72 Computing Expenditures At Illinois Public Universities

LINE ITEM	AMOUNT (000's)	% OF TOTAL
Personal Services	6814	47.6
Contractual Services	6507	45.5
Commodities	470	3.3
Telecommunications	193	1.3
Equipment	30	.2
Other Expenses	303	2.1
Total Operating	14317	100.0

The greatest portion of computing expenditures goes to support the staff necessary to perform the various computing functions of management, operations, systems and programming, data entry, and clerical and statistical work. The Personal Services item consists of 770 positions, system wide, for an average annual wage per person of $8,849.35. Annual wages range from $3,372 to $27,620. Interestingly enough, most institutions continually complain about being under-staffed and indicate that they are unable to do all the computer work that is demanded of them. Yet, historically in higher education, there has been a one-to-one (or less) relationship between personnel and machine costs.[5] In Illinois there appears to be a slight over balance of personnel expenditures (1.05 to 1). If this is a valid rule of thumb, then the university system appears to have at least an adequate staff in relation to machine costs.

Current Inventory and Utilization. Table 8 shows a mainframe inventory as reported to the Board of Higher Education staff for FY72. Typically the universities have acquired large general purpose computers to process most of their work. This means that data processing, instruction, and research workers often compete for the same resource in fulfilling their computer needs. Quite often this causes internal conflict and pressures, especially with the faculty, when their service as measured by job turn-around degenerates because of higher priority (usually administrative) users.

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[5] R. E. Levien, etal, The Emerging Technology, Instructional Uses of the Computer in Higher Education, (Draft), September, 1970, pp. 192-196.

The University of Illinois campuses are unique in that they are the only system where computing support is functionally separated. Administrative data processing is processed on one computer, and research and instruction on another, each having separate budgets, staffs, etc. Seven of the thirteen university campuses have more than one on-campus computer facility. Normally these are special purpose computers for doing specialized types of research. For example, University of Illinois, Champaign/Urbana currently has over thirty different computers. In other cases, older generation computers have been retained in computer centers to supplement the larger general purpose computers.

Turning to the computer utilization portion of Table 8, fifteen of the computers listed can be classified as major computers (see mainframes with asterisks in Table 8), since they do the bulk of each university's work. In October, 1971, there were 744 hours available for computer processing. During that time, the fifteen major computers were scheduled for a total of 7519 hours for an average of 501 hours per month, i.e., 67% of the time available. Scheduled time is the time the center is open and manned for processing. It is not to be confused with the time available for user processing, or the time the computer is actually engaged in processing.

One standard of comparison that can be applied to university computer operations is the Management Information Division's (the State Computing Utility) standard of 528 operational hours per month. The university system appears to be operating, on the average, below the State standard. However, Table 8 shows that eight of the fifteen major computer centers were operating at or above the 528 hour workload, but only three were in the 600 hour range or above. Typically a center is considered near workload

TABLE 8

MAJOR COMPUTER MAINFRAME INVENTORY
ILLINOIS PUBLIC UNIVERSITIES

	MAIN-FRAME	PURCH.-P LEASE-L	CPU SIZE	HOURS AVAILABLE	HOURS SCHEDULED	CPU METER HOURS	DOWN HOURS
BOARD OF GOVERNORS							
Chicago State University	None	-	-	-	-	-	-
Eastern Illinois University	360/50*	P	256K/LCS	744	744	441	16
Governors State University	None	-	-	-	-	-	-
Northeastern Illinois University	360/30*	L	64K	744	380	220	6
Western Illinois University	360/50*	P	256K	744	544	370	14
Cooperative Computing Center(1)	360/50*	L	384K	744	315	NA	NA
BOARD OF REGENTS							
Illinois State University	360/50*	L	512K	744	532	455	NA
	1130	L	16K	744	532	188	NA
Northern Illinois University	360/67*	L	512K/LCS	744	620	620	18
	360/20	L	8K	NA	NA	NA	NA
Sangamon State University	None	-	-	-	-	-	-
SOUTHERN ILLINOIS UNIVERSITY							
Carbondale(2)	360/65*	L	512K/LCS	744	584	481	19
	1401	L	8K	744	210	NA	NA
Edwardsville	360/40*	L	256K	744	574	445	30
UNIVERSITY OF ILLINOIS							
Urbana: ADP	360/50*	P	512K	744	528	120	22
	360/20*	L	8K	744	352	290	6
Urbana: CSO	360/75*	P	1024K/LCS	744	617	129	126(3)
Chicago Circle: ADP	360/50*	P	256K	744	386	NA	11
Chicago Circle: CC	370/155*	L	1024K	744	385	NA	30
	1800	P	32K	NA	NA	NA	NA
Medical Center: ADP	360/40*	L	126K	744	475	277	4
Medical Center: RRL	370/155*	L	1024K	744	483	18	27
	1800	P	32K	NA	NA	NA	NA

Total hours scheduled for 15 major computers (indicated by *) = 7519 or 67% of hours available.

(1) Cooperative Computer Center serves Chicago State Univ. (2 terminals), Governors State Univ. (3 terminals) and Northeastern Illinois Univ.
(2) Does not include Vocational Technical Institute.
(3) Includes all time computer unavailable regardless of reason.

saturation if it is manned 90 to 100% of the time available. This is equal (at 90%) in October, 1971, to 670 hours. Only one of the universities reported scheduled time above this limit.

This analysis doesn't tell the whole story since utilization should also be measured by the amount of time the machine is processing when it is manned, inasmuch as conceivably, the center could be open and the machine idle. One standard used by Morrison-Rooney Associates, Ltd. in doing the university computer audits, was to determine the elapsed time each machine was busy. If the machine was busy 70 to 80% of the elapsed time available, then the machine was considered to be operating at or near saturation. However, saturation of equipment depended upon both elapsed processing time and scheduled time. None of the universities audited were in danger of becoming saturated, and most often, as depicted above, there appeared to be an excess of processing time available. Typically, the computers were busy 50 to 60% of the time available, and the time available was usually less than Management Information Division's standard.

Utilization Caveats. It is almost impossible to compare any of the utilization statistics reported by the universities. Unfortunately, good records were not kept and CPU utilizations, in some cases, were not even known. For another, machine utilizations in terms of CPU hours are deceiving since the definition of CPU hours varies from institution to institution, depending upon their type of computing system and time accounting system. CPU meter hours were not accurate, since they tended to over-state the utilization of systems with time sharing networks.

It is also dangerous to use utilization statistics without a knowledge of what is being processed on the computer. No effort was made to analyze whether or not the university was making effective use of the computer. Thus, it is possible that some systems exist on computers merely because the computer is a symbol manipulator and not as a result of a conscious analysis of the most cost effective way to manipulate those symbols. Further, there was no effort made by the Task Force to determine the efficiency of the programs utilizing the computer. There may be room for improvements in this area through better use of the computing system's resources. For example, the Task Force is aware of one such change in the university system that resulted in the execution time of a program being reduced from four hours to forty-five minutes.

Utilization Summary. System wide, there are some generalizations which can and should be made regarding university use of computers. These findings are borne out in part by the inventory and utilization information discussed above, and by the Technical Audit performed by the Board of Higher Education, as follows:

1. There exists significant excess capacity in the system; some estimates indicate as high as 50% in individual cases.
2. There exists a number of Dedicated Computer Facilities in the system. Since these have been exempt from any utilization analysis because of their specialized use, there seems to be a need for a State policy regulating their growth.
3. Utilization data for each major computer system is lacking. There needs to be a reporting and information system established to gather comparative statistics for analysis.

Distribution of Computer Costs by Function. An analysis of computing expenditures in the system shows that over half of the total expenditures are being devoted to administrative data processing. Table 9 shows a functional breakdown of these expeditures by system and institution. Figure 3 shows the total statewide distribution by system.

TABLE 9

FY72

SUMMARY OF COMPUTING EXPENDITURES
BY FUNCTION
ILLINOIS PUBLIC UNIVERSITIES

	NO. OF STAFF	ADMINISTRATIVE[4]	INSTRUCTION[4]	RESEARCH[4]	PUBLIC SERVICE[4]	TOTAL[4]	OPERATING COST PER STUDENT	COMPUTER RENTAL[4]	COMPUTER COST PER STUDENT	FROEHLICH ON-CAMPUS 1971 HEADCOUNT	SOURCE OF FUNDS[3] STATE[4]	FEDERAL[4]	OTHER[2,4]
Chicago State Univ.	15	173	8	-	-	181	$ 33.61	3	$ .55	5385	181	-	-
Eastern Illinois Univ.	24	412	164	32	3	611	69.51	291	33.10	8790	571	-	40
Governors State Univ.	8	57*	85*	-	-	142	204.31	-	-	695	142	-	-
Northeastern Ill. Univ.	21	259	89	5	2	355	48.75	107	14.69	7281	355	-	-
Western Illinois Univ.	23	297	142	-	-	439	32.01	184	13.41	13711	439	-	-
Cooperative Computing Cntr.	12	405	50	-	-	455	34.05[1]	269[1]	20.13[1]	13361[1]	455	-	-
TOTAL	103	1603	538	37	5	2183					2143	-	40
		73.4%	24.6%	1.6%	.4%	100%							
Illinois State Univ.	45	477	348	83	-	908	50.64	373	20.80	17930	908	-	-
Northern Illinois Univ.	79	660	354	549	9	1572	68.88	804	35.23	22819	1572	-	-
Sangamon State Univ.	7	81	-	-	-	81	51.62	-	-	1569	81	-	-
TOTAL	131	1218	702	632	9	2561					2561		
		47.5%	27.4%	24.6%	.5%	100%							
Southern Ill. Univ.-C	97	992	250	469	-	1711	76.44	610	27.25	22382	1711		
Southern Ill. Univ.-E	34	366	190	127	-	683	53.12	209	16.25	12856	683		
TOTAL	131	1358	440	596		2394					2394		
		56.7%	18.5%	24.8%	-	100%							
Champ/Urbana-UOADP	20	257	-	-	-	257		-			234	-	23
Champ/Urbana-ADP	158	1793	-	-	-	1793		318			376		1417
Champ/Urbana-CSO	83	-	1922	-	-	1922		1055			328	484	1110
TOTAL	261	2050	1922	-	-	3972	122.98	1373	42.51	32296	938	484	2550
		51.6%	48.4%			100%							
Chicago Circle-ADP	48	674	-	-	-	674		115			238	-	436
Chicago Circle-CC	35	28	657	383	-	1068		509			958	-	110
TOTAL	83	702	657	383		1742	89.93	624	32.16	19370	1196		546
		40.4%	37.7%	21.9%		100%							
Medical Center-ADP	38	647	-	-	-	647		200			307	-	340
Medical Center-RRL	23	95	176	274	273	818		465			473	98	247
TOTAL	61	742	176	274	273	1465	444.74	665	20.21	3294	780	98	587
		50.6%	12.0%	18.7%	18.7%	100%							
GRAND TOTAL	770	7673	4435	1922	287	14317	85.02	5512		168378	10012 (70%)	582 (4%)	3723 (26%)
$ PER STUDENT		53.6% 45.57	31.0% 26.33	13.4% 11.41	2% 1.71	100% 85.02							

* Estimated

[1] Combinedoperating costs and students of cooperating institutions

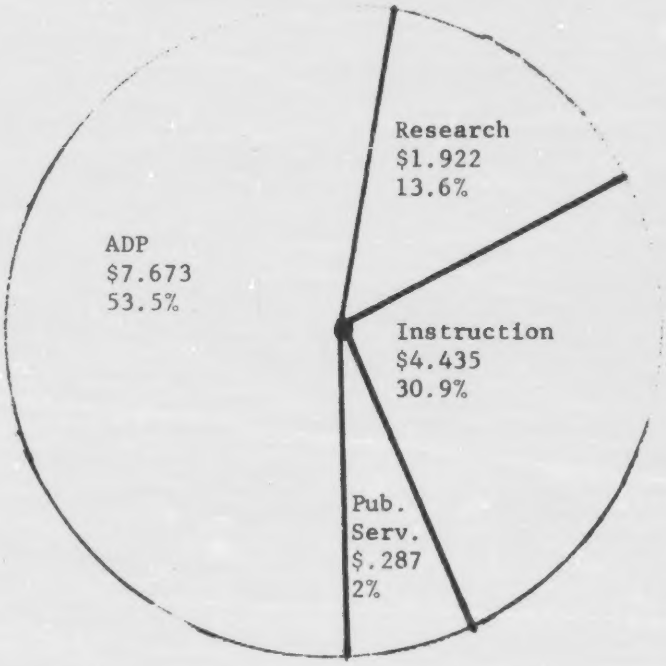
[2] Usually represents billings to other departments

[3] Adjusted to not include retirement

[4] Thousands of dollars

Figure 3

State University System Functional
Distribution of Operating Computer Expenditures
for FY72 (in millions)



Analysis of the data in Table 9 gives a rough indication of where the emphasis is placed in each of the public university's computing services. The Board of Governors system evidently places their greatest emphasis on administrative data processing (ADP), since 73.4% of their expenditures are here. The Board of Regents system at 47.5% reports the lowest percentage of expenditures for this activity.

Analysis of the data in Table 9 alone would indicate that Southern Illinois University and the Board of Regents system place the heaviest emphasis on research computing. Yet, the University of Illinois performs 87%

of the research computing in the public higher educational system (see the following section: Research Demand for Computer Services). However, 75% of the research computing at the University of Illinois is performed on Dedicated Computing Facilities (DCF) which are largely supported by outside fund sources. No estimate of the State funds used to support these activities is included in Table 9.

The emphasis on instructional computing seems to be the greatest at the University of Illinois, at 38.4% of their expenditures, and the least at Southern Illinois University, at 18.5% of their expenditures. The Urbana campus of the University of Illinois devotes 48.4% of their total computing funds to instruction. However, this figure overstates the case since all costs of computing activities in the Computing Services Office at the Urbana campus were allocated to instruction. Actually, the computer utilized at that center provides 19% of the total State research usage. To some extent, then, research usage is under-reported and instructional usage over-reported for Urbana. Actual billings for computer services shows the cost of operations to be allocated as follows: Instruction, 57%; Research, 42%; and Other, 1%. This breakdown, however, is a function of the billing algorithm. Actual usage for a recent five month period shows the following CPU activity: Instruction, 28%; Research, 57%; and Other, 15%. Nothing is really known about personnel assignments (32% of the budget). Thus, one can only speculate that the cost of instructional computing at the University of Illinois is in the range of 575 thousand to 1.1 million dollars and represents 14% to 28% of the budget.

To date public service computing has not been required to support the existing public university computing centers. The notable exception has been the Medical Center campus of the University of Illinois. The Research Resources Laboratory (RRL) has done an outstanding job in this area, deriving a large portion of its income from this source. Among other projects, they provide the computer service for the only trauma registry in the nation. They are also providing educational services via a national network operated by TYMSHARE Incorporated, a commercial computer utility.

Public service computing would probably be more widespread except for the problems of budgeting for an pricing of services. Normally, each center is fully funded with State appropriations and even if the centers charge for services on a cost recovery basis only, it amounts to double funding. Even then, quite often the computer center ends up not receiving the funds, but they are funnelled off to general universities operations. Thus, there seems to be little incentive in performing such public services even though there appears to be a large latent demand for such services. The Medical Center campus, on the other hand, actually budgets for a portion of the support of the RRL to come from public services. Because of their excellent staff management and setting, they have been able to attract these users.

The point that needs to be emphasized in reviewing these costs is the extremely high percentage of funds being consumed by ADP as opposed to the other types of computing. The ADP portion of this report will focus on how these funds are being used with an eye toward finding new approaches to ADP in hope of lowering these costs. Any potential savings should be diverted to instructional computing in order to better serve students.

Computing Cost Per Student. Since one of our goals is to find ways to reduce unnecessary costs and thus, the overall rate of growth in computing cost per student, it is necessary to view a current profile of cost per student. The Regner Report made a serious attempt at developing cost per student for the university system, but it stopped short of total computing costs by showing cost per student using State funds only. Using total funds results in a somewhat different picture. Using the information discussed above, cost per student for computing expenditures (as shown in Table 9) is shown in Figure 4 below:

Figure 4

State University System
Summary of Total Computing Cost
Per Student by Function
FY72
Total Cost Per Student = $85.02

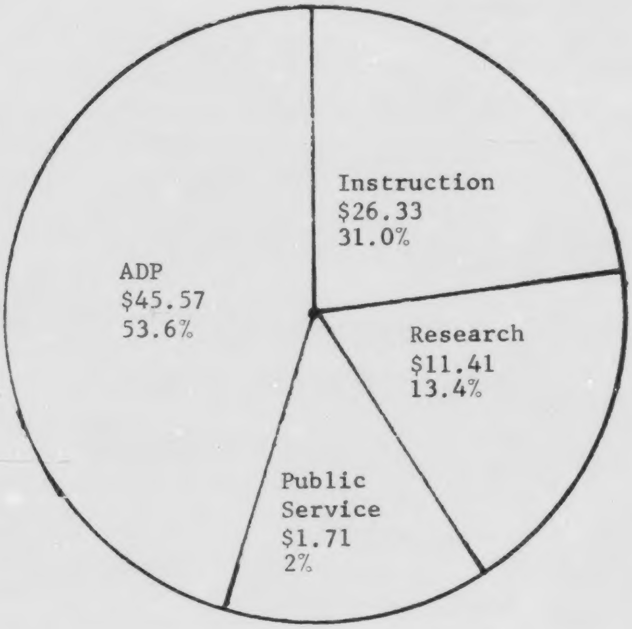


Table 9 shows total operating cost per student for each university and campus. Western Illinois University shows the lowest cost per student at $32.01 and the Medical Center the highest at $444.74. The overall State average including the Medical Center is $85.02, and without, $77.85 per student.

Viewing these costs by system shows the highest cost system to be the University of Illinois at $130.62 per student, and the lowest cost system to be the Board of Governors at $48.18 per student. Again, it should be emphasized that DCF's are not included in these figures. The cost per student varies widely by system:

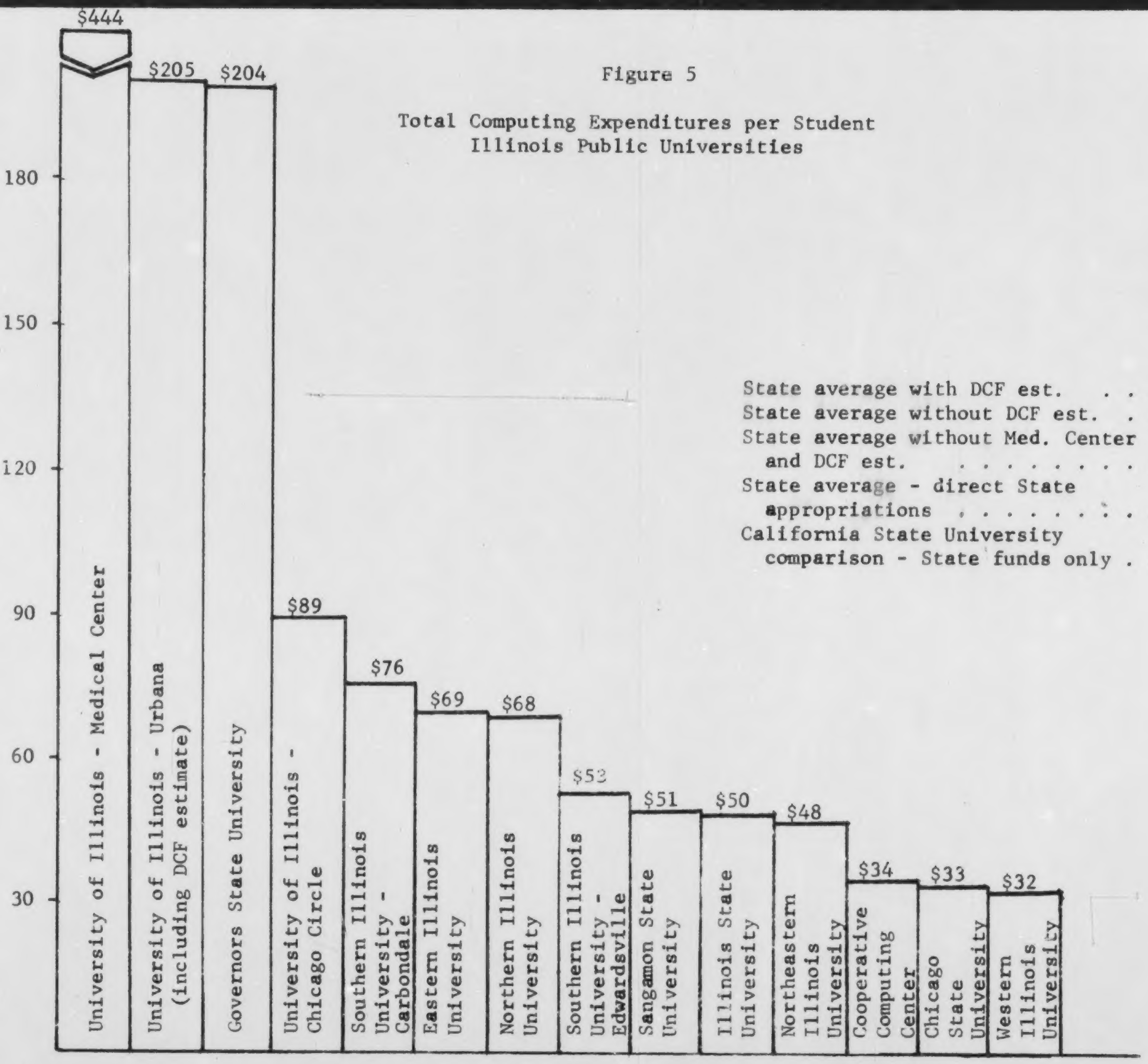
SYSTEM	COMPUTING COST PER STUDENT
Board of Governors	$ 48.18
Board of Regents	$ 60.50
Southern Illinois University	$ 67.94
University of Illinois	$130.62

Table 10 shows a functional breakdown of each institution's and system's cost per student. An estimate of the out-of-pocket cost of the major DCF's at the University of Illinois-Urbana is included in this table. Also, instructional and research costs for the Computer Services Office at that campus are allocated based upon computer usage (as discussed in the previous section). When the estimated cost of DCF's is included, the University of Illinois' cost per student becomes $179.09. Figures 5 through 8 show comparative bar charts of the cost per student by functional area (except public service). No attempt has been made to draw any conclusions from this data, mainly becuase no comparative data exists from which valid conclusions can be made.

Continuing work needs to be done to establish standards for funding, based primarily on the types of data shown above. Cost per student standards ought to be set for each type of computing varying somewhat by system and institution in order that institutions will know specifically what the State will and will not fund in the way of computing expenditures. One example might be to establish the size of on-campus configuration the State is willing to fund for each institution which could vary, primarily, by

Figure 5

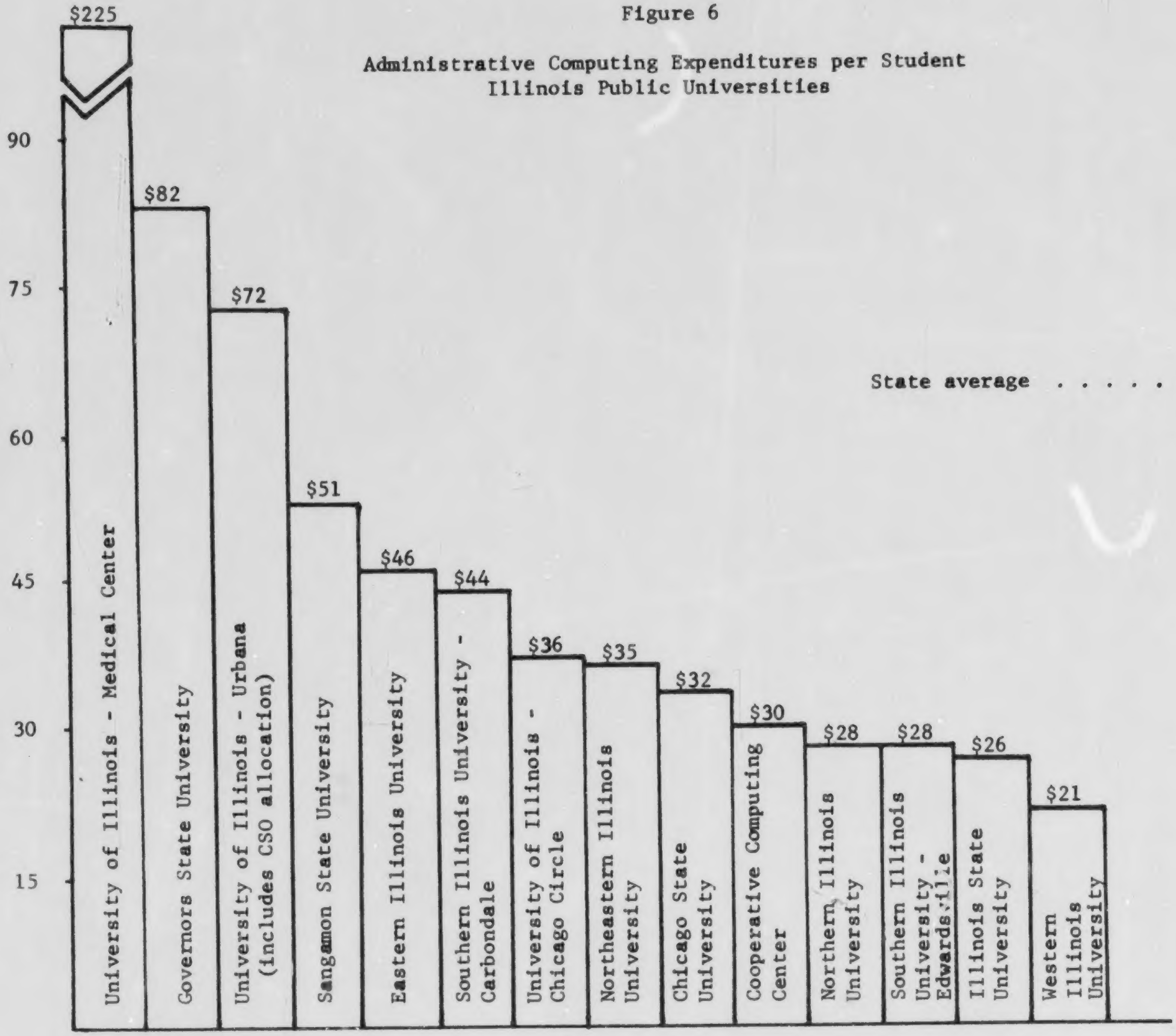
Total Computing Expenditures per Student
Illinois Public Universities



State average with DCF est.	$100.85
State average without DCF est. . . .	85.02
State average without Med. Center and DCF est.	76.32
State average - direct State appropriations	59.46
California State University comparison - State funds only . . .	28.00

Figure 6

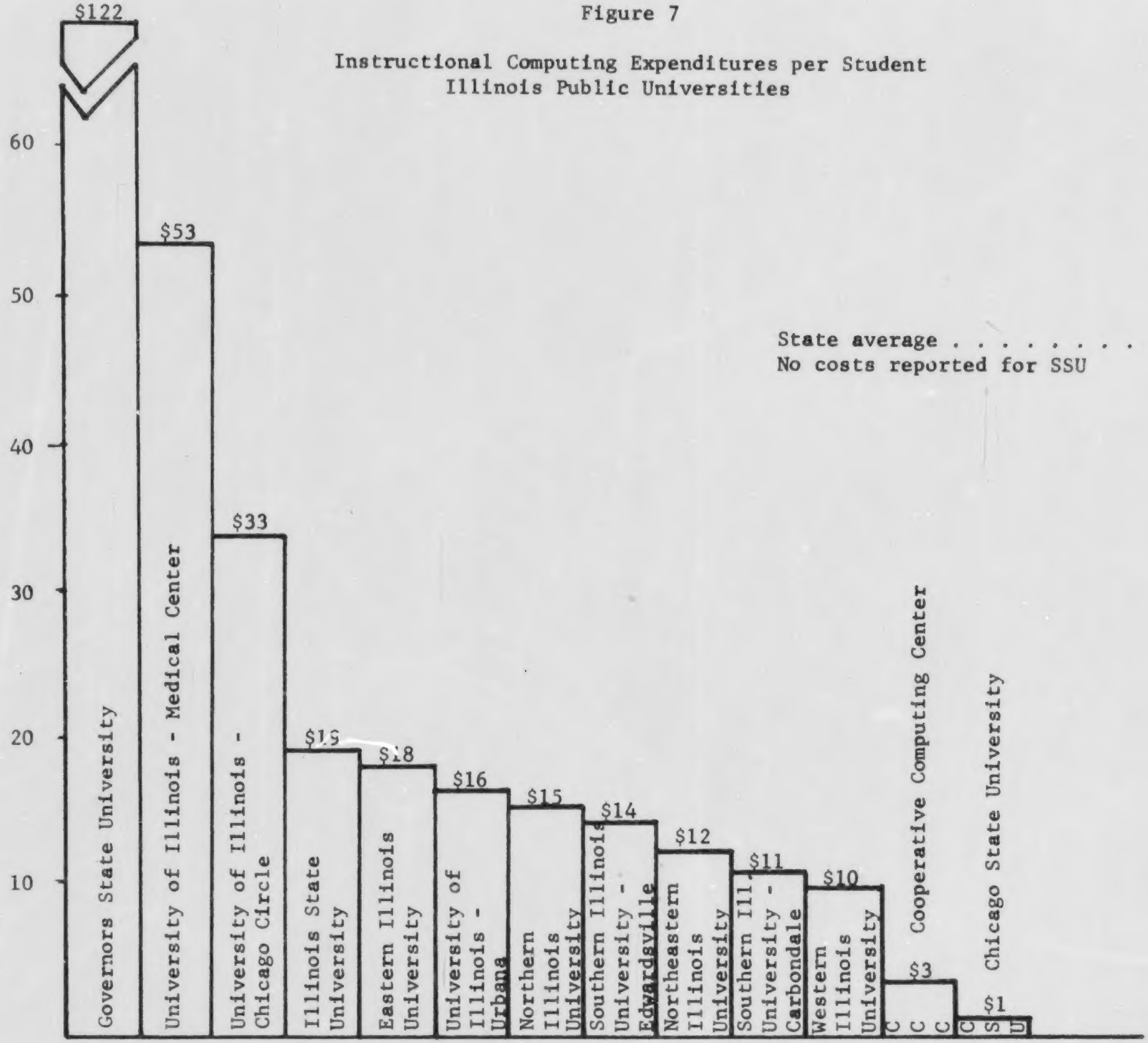
Administrative Computing Expenditures per Student
Illinois Public Universities



State average $47.28

Figure 7

Instructional Computing Expenditures per Student
Illinois Public Universities



State average $18.12
No costs reported for SSU

Figure 8

Research Computing Expenditures per Student
Illinois Public Universities

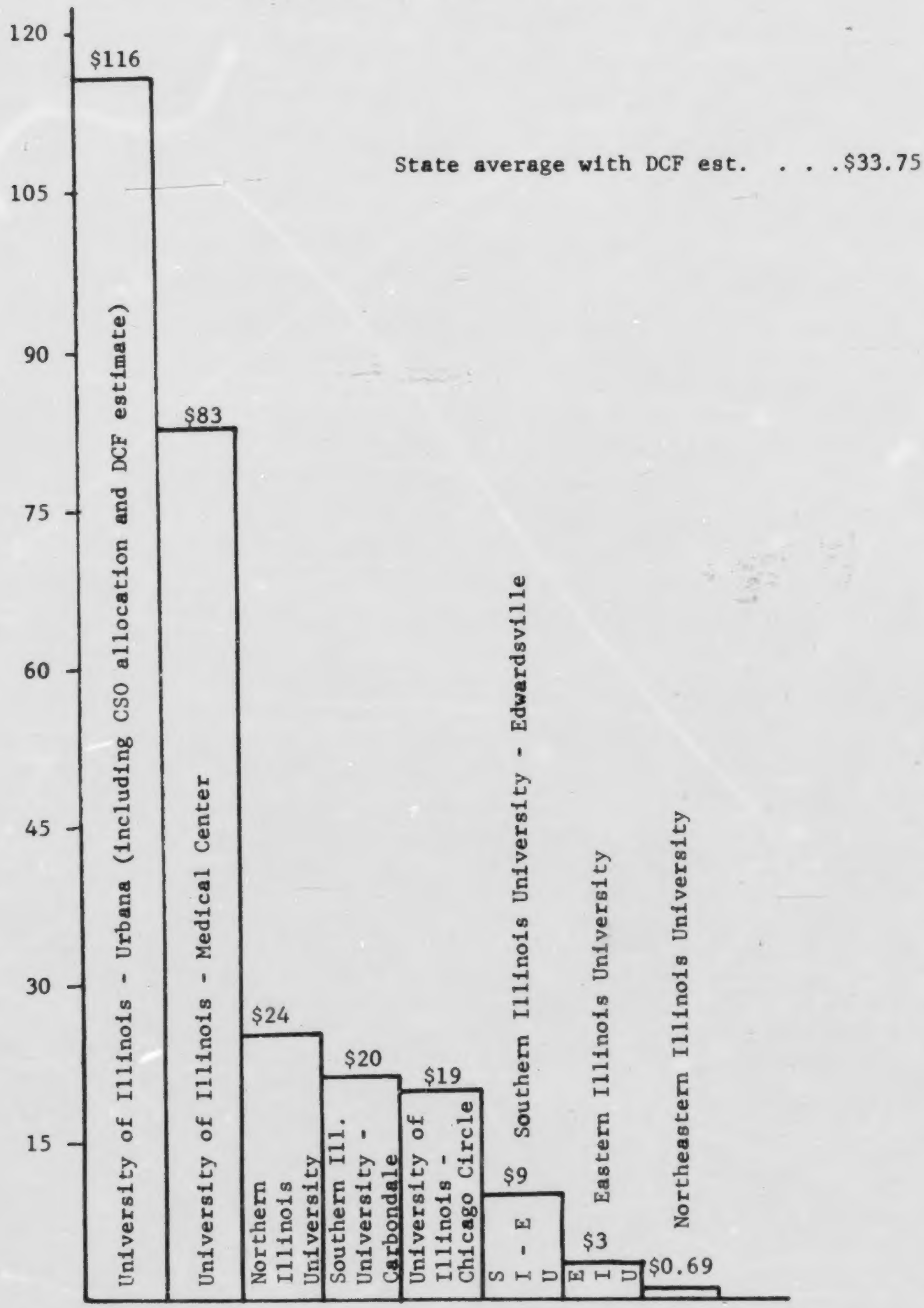


TABLE 10

FY72
SUMMARY OF COMPUTING EXPENDITURES PER STUDENT
BY FUNCTION
ILLINOIS PUBLIC UNIVERSITIES

	ON-CAMPUS 1971 HEADCOUNT	ADMIN. COST/STUDENT	INSTR. COST/STUDENT	RESEARCH COST/STUDENT	PUB. SERV. COST/STUDENT	TOTAL COST/STUDENT
Chicago State University	5385	32.13	1.48	-	-	33.61
Eastern Illinois University	8790	46.87	18.66	3.64	0.34	69.51
Governors State University	695	82.01(a)	122.30(a)	-	-	204.31
Northeastern Illinois University	7281	35.57	12.22	0.69	0.27	48.75
Western Illinois University	13711	21.66	10.35	-	-	32.01
Cooperative Computing Center(b)	13361	30.31	3.74	-	0.15	34.05
TOTAL	35862	33.40	13.60	1.03	0.14	48.18
Illinois State University	17930	26.60	19.41	4.63	-	50.64
Northern Illinois University	22819	28.92	15.51	24.06	0.39	68.88
Sangamon State University	1569	51.62	-	-	-	51.62
TOTAL	42318	28.78	16.59	14.93	0.21	60.50
Southern Illinois University						
Carbondale	22382	44.32	11.17	20.95	-	76.44
Edwardsville	12856	28.47	14.78	9.87	-	53.12
TOTAL	35238	38.54	12.49	16.91	-	67.94
University of Illinois						
Urbana	32296	72.39(c)	16.66(c)	116.42(c)	-	205.47
Chicago Circle	19370	36.24	33.92	19.77	-	89.93
Medical Center	3294	225.26	53.43	83.18	83.18	444.74
TOTAL	54960	107.33	38.91	125.35	4.97	179.09
STATE TOTAL/AVERAGE	168378	47.28	18.12	33.75	1.70	100.85

(a) Estimated
(b) Combined operating costs and students at Chicago State University, Northeastern Illinois University, Governors State University
(c) Estimated at:

Admin. Cost/Student = (ADP reported figure + CSO Budget x .15)/32,296 students.
Instr. Cost/Student = (CSO budget x .28)/32,296 students.
Research Cost/Student = (CSO budget x .57 + DCF hardware cost + .4 DCF hardware cost)/32,296 students where DCF hardware cost is $1.903 million (as shown in Table 19) and .4 x DCF hardware cost is estimate of personnel and other costs associated with DCF's.

enrollment and institutional mission. Having established the size of configuration, then the total computing budget could be determined by multiplying this amount times a factor which shows the relationship between equipment costs and total computing costs. For Illinois, in FY72, this factor was approximately 2.6 to 1. The amount formulated could then be adjusted to account for statewide standards of cost per student for different types of computing service. All of the parameters could be heavily influenced by such factors as the historical percent of computer expense to total operating budgets (for FY72, computer expenditures as a percent of total operating budgets was 3.52%), statewide computer consolidation as specified by the proposed public-interest corporation, or other statewide higher education funding policies.

Future Funds Demand for Public University Computer Resources

Growth Projections. The demand for computer funds continue to spiral upward. Computing expenditures have grown much faster than State higher education expenditures in general and yet, paradoxically, there exists significant excess capacity at virtually every school. University requests for additional computing funds for FY73 indicate that while the growth rate has leveled off, it continues to grow at over 16% a year, a rate higher than the inflationary factor and the growth of enrollment. An analysis of these requests leads to the following interpretations:

1. The larger schools seemed determined to acquire the newest line of IBM computers, namely the IBM 370 series. Both campuses of Southern Illinois University were requesting funds for IBM 370 computers; yet apparent cost justification for such a move is missing. The technical audit shows currently that both have significant excess capacity. The Medical Center and Chicago Circle campuses of the University

of Illinois both have already acquired 370's, and Northern Illinois University and Champaign/Urbana ADP are currently engaged in feasibility studies for 370's.

2. Each university is trying to acquire enough equipment, computer capacity, and staff to provide stand alone interactive computing service. If the school already has an interactive computing network, then it is trying to expand this service. The need for the service comes primarily from the faculty who say they want it as an added dimension for student instruction. Yet it is a rare faculty member who has estimated the load and level of service necessary. Also, the technical audit points out that current interactive terminal systems are not reaching the students at all, but are primarily under the control of faculty members and the computer center staff. In ADP too, there is a demand for interactive processing and display as institutional management moves toward data management systems to update and retrieve information. An example of this demand is shown in Table 11, which lists by university the current inventory of terminal devices along with the number of new terminals being requested. New requests practically equal the current inventory.

3. Each university wants to continue to autonomously develop and maintain its own data systems in a vacuum and with little or any regard to what the statewide cost and implications may be to support this development.

Assuming that the need for the above services is well founded, there are several consolidation schemes that might provide it at a cost lesser than current costs. All of these alternatives rest on the valid assumption that users need access to computers, rather than access to on-campus computer facilities. Also, they presume that systems development and implementation needs can be satisfied by an arrangement calling for centralized systems development.

The impact of providing these services on either a stand alone or consolidated basis must be evaluated to determine the future demand for State

TABLE 11

INTERACTIVE TERMINALS

	ON HAND JANUARY 1972	REQUESTED FY72-73	TOTAL
BOARD OF GOVERNORS			
Chicago State University	2	7	9
Eastern Illinois University	22	4	26
Governors State University	3	35	38
Northeastern Illinois University	2	0	2
Western Illinois University	2	0	2
Cooperative Computing Center	2	0	2
BOARD OF REGENTS			
Illinois State University	4	15	19
Northern Illinois University	40	0	40
Sangamon State University	1	1	2
SOUTHERN ILLINOIS UNIVERSITY			
Carbondale	4	25	29
Edwardsville	0	5	5
UNIVERSITY OF ILLINOIS			
Champaign/Urbana	34	7	41
Chicago Circle	30	0	30
Medical Center	27	41	68
	173	140	313

funds in support of university computer resources. Table 12, below, shows the comparative impact of current university computer expenditures ($14,317,000) continuing to grow at 15% (slightly less than the current rate) and at a 5% rate which is at about the inflationary rate. The 5% rate is more in tune with fiscal reality and more properly shows the total expenditure growth rate the State will probably be able to fund over the next several years. It will cost a total of $82.4 million more by 1980 to provide services at the existing growth rate than to provide the services at the lower rate.

TABLE 12

Projected Annual Total Computer Costs at
Illinois Public Universities
Base Line Year FY72
(in 000's)

FISCAL YEAR	5% INCREASE	15% INCREASE	5% INCREASE
72	$ 14,317	$ 14,317	--
73	15,033	16,465	$ 10,836
74	15,784	18,934	11,378
75	16,573	21,774	11,920
76	17,402	25,041	12,461
77	18,273	28,797	13,112
78	19,186	33,116	13,762
79	20,145	38,083	14,520
80	21,153	43,796	15,170
TOTAL	$157,866	$240,323	$108,252

The last column of Table 12 presents an added dimension to the discussion. The base line year and amount is changed to incorporate the Board of Higher Education's operating budget recommendations for computers for FY73 which can be seen to grow at 5% for the foreseeable future. These recommendations were based on the following:

1. Partial consolidation of computers where technically and economically feasible, incorporating

the funding of added telecommunication costs where necessary to connect computers to take advantage of currently existing excess capacity.

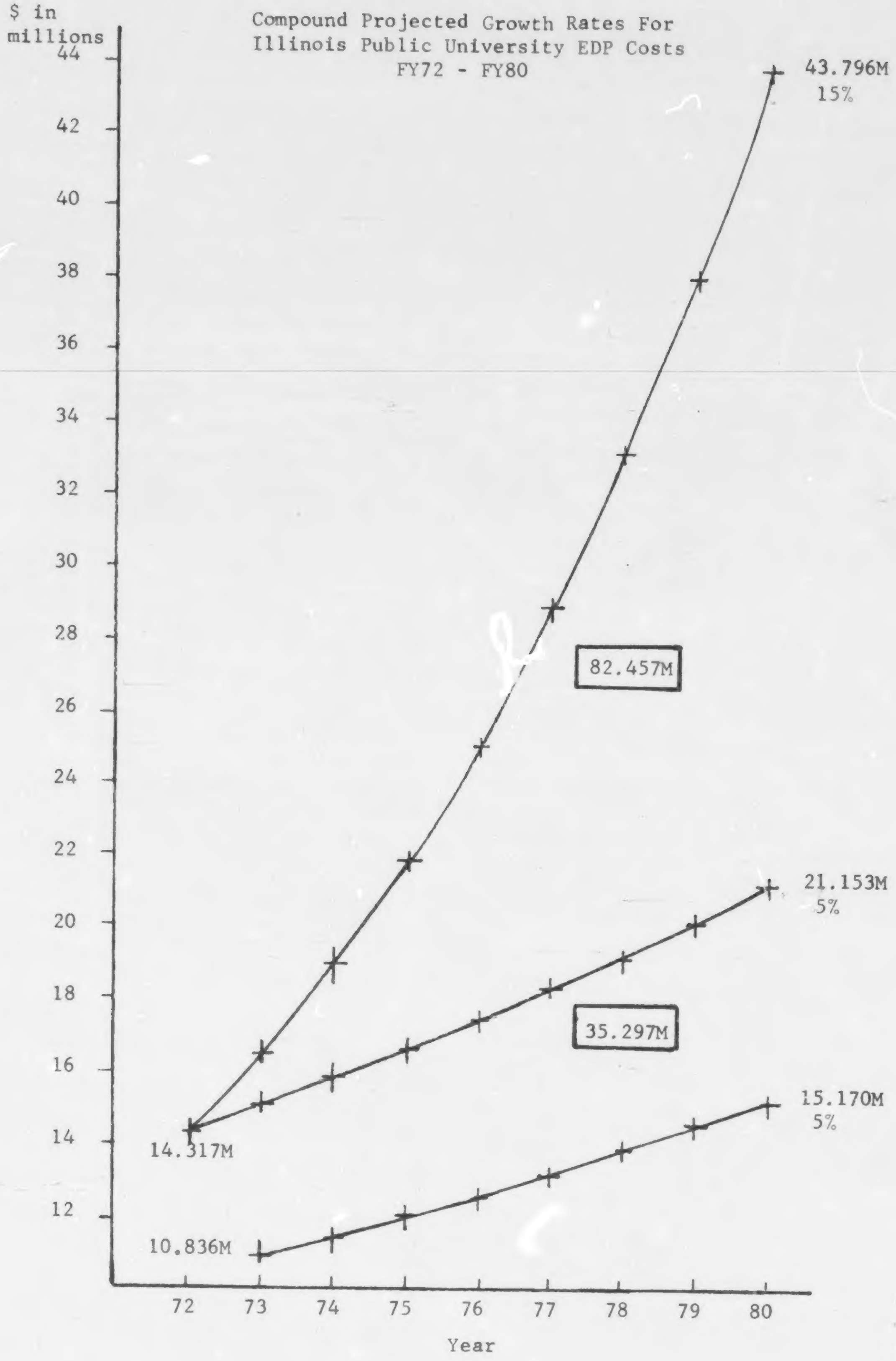
2. The purchase of selected computers where cost/benefit could be demonstrated.
3. Reduction of personnel where either overstaffing existed, or development duplication could be demonstrated.

The team of consultants working on this project, which was jointly funded by the Board of Higher Education and the Department of Finance, knew that this was only one of a series of alternatives that could be recommended as the basis for consolidation; others have surfaced since that time. But it was plain to see, in the time allowed, that this arrangement could lead to immediate cost savings while having little effect in continuing current service levels. Having been proven cost beneficial to both institutions and the State, it was recommended to the individual universities for implementation. Under this arrangement and assuming a 5% annual growth rate between FY73 and FY80, the State can avoid $117.7 million of unnecessary cost compared to the current arrangement. This is not a net savings figure, however, since some provisions need to be made for future centralized systems development which is certain to increase cost, but not at current growth rates, however. Figure 9 graphically demonstrates the cost avoidance impact of these alternatives.

Summary. The State can no longer afford the luxury of funding each university with enough computer resources to do all of its computing work. Particularly when it is demonstrated that, over the period 1972-1980 significant cost avoidance can be realized through consolidation of computer equipment, software development, and the sharing of other types of computer expertise. A delivery system must be found that will provide computer

Figure 9

Compound Projected Growth Rates For
Illinois Public University EDP Costs
FY72 - FY80



service better than it is being provided for now, and at a better price.

The impact of this statement to the universities means:

1. Making better use of current funds to provide for new needs.
2. Reconciling themselves to the fact that large on-campus computers are not necessary to get good computer service; what is necessary is access to such computers via a regional computer network arrangement.
3. An absolute necessity to share computing expertise among sister institutions. This fact is the most difficult of all, for university administrators and computer managers to accept, since they are accustomed to "doing their own thing."
4. That State funds requested for new computer resources will not be available for requests that exceed (1) the rate of growth of State income, or (2) the rate of growth of student enrollment.

Characteristics of Computer Service

Traditionally, computers have served the higher education community in all areas of endeavor: administration, instruction, research, and public service. The computer originated on a university campus, and while it was for a time an object of research at the larger universities, including the University of Illinois, it soon found its way into the instruction process and finally into the administrative process. With the exception of the University of Illinois, this pattern of development generally was not the case at other Illinois universities where the computer first was used as a tool for automating manual accounting and administrative procedures. Once on campus it was soon used for instruction and research, but the main priority user continues to be administration. To provide the entire spectrum of services, seven universities have organized full service computer centers where all user jobs are processed. Additionally, the Board of Governors system established at the beginning of FY72 a full service computer utility located on the Chicago State University campus which will ultimately handle the total workloads of Chicago State University, Governors State University and Northeastern Illinois University. Also, within the University of Illinois system, each campus has at least two centers; one dedicated to ADP work and one dedicated to research and instruction work. Each center has separate staffs and budgets. In total there are eighteen major computer centers (and development staffs) that were included in this study. Actually there exists a number of other computer installations in the university system but because of their special purpose character they were not included.

The computing centers which were investigated are attempting to provide four types of computing which appear to be common to higher education. These can be characterized as follows:

1. There are a number of interactive terminal services which are used to support conversational computing, i.e., where the user and the computer programs interact frequently, or which permit job creation and submittal using teletypewriter, typewriter or video display terminals. This computing is characterized by a load which approximates the peak activity hours of an institution, 10:00 A.M. to noon and 2:00 to 5:00 P.M., and the necessity for complex systems software to control the telecommunications equipment.

2. There are student batch jobs -- typically Fortran, COBOL, or PL/I jobs which are submitted for compilation and testing. The principal requirement is for the return of results in a time period ranging one to three hours after submission in order that educational effectiveness is maintained. The jobs usually depend on manufacturer provided compilers and some special language processors or packages which have been developed by and for institutions of higher education.

3. A general class of computing where faculty and students are using the computer as a problem solving tool. This includes the general scientific computing to support research and instruction. Extensive software support and equipment requirements -- CPU speed, large core size, or extensive storage, are typical. A variety of levels of service are required -- sometimes immediate results are needed, other times results can be delayed for several days.

4. Administrative data processing which is characterized by software systems especially developed or installed to provide for the administrative and management functions of the institutions. Typically this data processing support is closely coordinated with the administrative offices and has rigid schedule requirements.

There are a number of points which can be made to generally describe the operations of the existing computing centers in their provision of the services described above:

1. Each center has a full complement of staff for computer operations, system development, I/O preparation, and programming.

2. Typically staffs are organized by function: Administrative Data Processing, Research, Instruction, and Operations. Research and Instruction programming and development staffs tend to be the smallest component because most of the programming and usage is by students and faculty members.

3. Operations are primarily of a "hands off" nature in that users submit jobs to the center for processing and return to them; they are usually not permitted to operate the equipment and process their own jobs.

4. Computer centers are typically aligned under the chief administrative officer of the university.

5. Computer center directors usually come from an academic department, typically as a tenured faculty member, rather than having industrial computing experience.

6. The mode of operation for all types of service is primarily batch processing. Interactive computing usually represents less than 10 to 15% of total processing, although a few schools are exceptions to this.

7. There is very little remote batch or remote job entry processing.

8. Each center within a system has grown for over fifteen years in a completely independent and autonomous nature. While there have always been informal communications between directors relative to solving day-to-day operations and development problems, still there is no evidence to support the sharing of computer resources among systems.

9. With one exception, the universities have not formally planned the growth of computer resources except from one budget cycle to the next.

10. The demand for computer services has been growing at a rapid pace and even though this pace will lessen in the period 1972-1980, demand will continue to expand.

11. Users of this service are extremely sensitive to job turn-around, i.e., they can never understand why the turn-around cannot be immediate. Because of this quirk of human nature, it is impossible to keep all users happy, and it creates continuous tensions on computer center management to improve turn-around times.

12. On the other hand, generally there is no mechanism that provides priorities for service. Consequently, the computer center director, influenced at times by a "user committee," sets formal or informal policies which influence levels of service, e.g., job turn-around.

13. Most often, data centers are required to justify the total computer center budget rather than requiring the users of the data center to justify their own budgets and have the users pay the data center through a management revolving fund.

Instructional Demand for Computing Services

Public Universities. The current situation in instructional computing can best be typified as one of anticipation rather than one of actual current activity. Table 13 gives an indication of the depth of penetration of the computer into the instructional process at the public senior institutions. Albeit, these data reflect 1969-70 usage, actual audits of computing services conducted as part of the FY73 budget review process, indicate that instructional usage has not increased greatly at many of the schools.

In analyzing the data in Table 13, it should be emphasized that column three is the ratio of student users to headcount and not a percentage of the student enrollment using the computer. The extent of duplicate counts of students using the computer because of their enrollment in more than one course is unknown.

The University of Illinois at Urbana appears to be the only campus that has made a widespread penetration of the instructional process with computer related techniques. In FY70 their ratio of student use to headcount was .61. Additional data provided by University of Illinois-Urbana for FY71 indicates that student enrollment in courses using the Computer Services Office's computer increased from approximately 18,000 to 30,000 -- a 66% increase. Approximately 14,700 were unique enrollments. If each student enrolled actually used the computer in his course work (rather than having the use be optional or for extra credit), then this enrollment figure indicates that approximately 60% of the undergraduate enrollment (24,341 for Fall, 1970) at Urbana was actually exposed to the computer during FY71.

Public Junior Colleges. Complete data on the use of computers in public junior colleges is lacking. However, it can be safely said that their current emphasis in using the computer in instruction is different than the public senior institutions. Although computer utilization is encouraged for all instructional areas, as with senior institutions, the

TABLE 13

STUDENT USE OF COMPUTERS IN THE INSTRUCTIONAL PROCESS
(Obtained From A National Science Foundation Survey Of Illinois Public Universities)

INSTITUTION	FALL 1969(1) HEAD COUNT	1969 STUDENT USE	RATIO: STUDENT USE TO HEADCOUNT	% STATE USE
University of Illinois				
Urbana-Champaign	32759	20243	.61	58
Chicago Circle	16234	3419	.21	10
Medical Center	2933	190	.06	0
U of I - Subtotal	(51926)	(23852)	(.45)	(68)
Southern Illinois University				
Carbondale	23002	967	.04	3
Edwardsville	12152	95	.00	0
SIU - Subtotal	(35154)	(1062)	(.03)	(3)
Board of Governors				
Western Illinois University	11112	1027	.09	3
Eastern Illinois University	7887	1239	.15	3
Chicago State University	5473	60	.01	0
Northeastern Ill. University	6732	730	.11	2
BOG - Subtotal	(31204)	(3056)	(.10)	(8)
Board of Regents				
Northern Illinois University	817(2)	4438(2)	.19	13
Illinois State University	14687	2700	.18	8
BOR - Subtotal	(37404)	(7138)	(.19)	(21)
STATE TOTAL	155688	35108	.23	100

(1) Source: Enrollment in Institutions of Higher Learning in Illinois:1970; G. J. Froehlich & A. R. Lewandowski

(2) Only data available for Northern Illinois University are for 1970-71 student use

junior colleges emphasize vocational programs to provide computer language-oriented curricula, compatible with position requirements in the local job market. Thus, in 1969, thirty-six of the forty-six junior college campuses offered "programmer" courses. Fifteen campuses offered courses in operator training.

Private Colleges and Universities. Complete data on the instructional use of computers in private colleges and universities is also lacking. However, it is the feeling of the Task Force that only three or four of these institutions have as much or more than the average usage at the public senior institutions.

A survey of institutions in the Federation of Independent Illinois Colleges and Universities was taken to determine the load these schools might be expected to put on a network. Ten of the nineteen institutions responding indicated they would utilize such a network for student job processing. The rest of the institutions indicated they would process no jobs on such a facility or gave no response to the question. Since several levels of cost were given, it can be assumed that lack of knowledge about the cost of such an arrangement was not a factor in the institution's decision not to favor participation in network activities. At least two interpretations, both of which may be equally valid, can be given to this finding.

First, it is possible that an institution would not utilize outside services until its local computer is saturated. Such is the case at Northwestern University where Mr. Earl J. Freise, a representative of the Office of Research and Sponsored Programs, responded:

> "It is difficult to estimate the number of terminals and terminal hours per month which would be used at the rates given since at present our computer is not

> operating at saturation and unless either saturation was reached in the 1973-74 year or the entire computer complex was phased out, interactive computing would be handled through the present system. The same considerations also apply to remote job entry. At present, remote job entry is used for batch processing and again until saturation is reached, there would be little call to go outside for this service."

A second interpretation is that the cost per job is not the only critical factor for student job processing either remotely or on-campus. This appears to be the case for at least two colleges, neither of which indicated an increase in their number of jobs per month even though the questionnaire proposed reduced costs per job. This is perhaps best summarized by the response of Mr. Robert Langlois, Associate Vice President for Analytical Studies at DePaul University, who stated:

> "On the other hand, if we were in a remote job entry production mode, it is doubtful that lower costs would be the key variable to increased student jobs per month as assumed by this question. The key variable would be how much time and effort faculty is willing to expend to create courses where computers can be used as problem solving tools or where learning programming becomes the object of instruction."

It can be concluded that in the near future the additional load that the private institutions would place on an instructional network is small.[6] Less than 20,000 student batch jobs per month were predicted by the institutions to be run remotely. This is less than half of the jobs the Computer Services Office at the University of Illinois-Urbana is processing in a month in utilizing 30% of their computer for instructional purposes. Interactive use would also be small. The private institutions indicated that if the cost per terminal hour of operation were kept below $1.00 per hour, then they would expect to use 59 terminals an average of 186 hours per month. A recent proposal by a major computer manufacturer indicates that such costs are feasible.

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[6] Care must be taken here. The University of Chicago, Illinois Institute of Technology, and Northwestern University did not submit estimates of their usage. It is assumed that these three institutions are among the top users of the computer in the instructional process, and if they choose to participate, they would place a heavy load on any network activity.

Interactive Computing. The desire for interactive terminal capability is also present at the public senior institutions. Currently, there are 173 such terminals in the system. Approximately 50% of these are being used by students in their instructional programs. The development of this capability at all institutions has been restricted, even though it is considered to present the best learning environment. Such service, however, is costly and the institutions have been unable to afford the computer overhead and systems support necessary to support the service.

Computer Assisted Instruction (CAI). The direct application of computers has caused a great deal of controversy over the potentiality of this concept. Commonly referred to as computer assisted instruction (CAI), many of these programs were originally initiated with the intent of increasing educational productivity by applying computer technology to:

1. decrease costs per student contact hour as compared to conventional teaching methods.
2. increase effectiveness by providing individualized instruction based upon the individual student's preparation, motivation, pace, and style.

Most attempts at computer assisted instruction to date have been unsuccessful. Some of the failures have been due to ill designed approaches restricted to "programmed learning" where the computer has virtually complete control over the lesson sequence. However, the overwhelming reason for the failure of more ingenious uses of CAI has been the unfavorable comparison of the cost of this method of teaching to the more conventional methods. This has arisen from the scale and methods of implementation in the past.

The PLATO project at the University of Illinois-Champaign/Urbana campus appears to have overcome many of these difficulties. The PLATO-III system has demonstrated the educational possibilities of employing CAI. The design of PLATO-IV has been a conscious effort to apply the total systems concept to economic development of CAI.[7] Central computing hardware and software, terminal consoles, communications, teaching strategies, teaching program languages, and installation management have been addressed as a system in this development. Based on an annual use of 8.2 million contact hours, it has been estimated that the operational cost for a 4000 terminal PLATO-IV system will be thirty-four to sixty-eight cents per student-contact hour.[8] This compares with an approximate direct instructional cost of $2.60 per student contact hour in the public senior universities in FY70.[9]

Future Prospects. How fast and how thoroughly the computer will be integrated into the course work at the colleges and universities in

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[7] For a complete description of the PLATO project see Alpert, D. and Bitzer, D.L., "Advances in Computer-Based Education," Science, March 20, 1970, Vol. 167, pp. 1582-1590, and Bitzer, D. and Skaperdas, D., "The Design of an Economically Viable Large-Scale Computer Based Education System," CERL Report X-5, Feb. 1969, rev. Sept. 1971, University of Illinois, Urbana, Illinois.

[8] Alpert, D. and Bitzer, D.L., "Advances in Computer-Based Education," Science, March 20, 1970, Vol. 167, p. 1589.

[9] $184,677,000 ÷ (155,490 students x 450 contact hours/student/year). Financial data and student data from Table 4.

Illinois is open to speculation. The Instructional Subcommittee projected that by 1980, 90% of all entering college students would be exposed to a course in computers. It is doubtful if this prediction will be met without a commitment from the top level administrator at an institution. Nearly 90% of all Dartmouth College's undergraduates gain familiarity with computing today.[10] But there are too few administrators who support such activity as does Dartmouth College President, John G. Kemeny, who has stated:

> "It has been a long time since a college or university has been accredited that did not have a decent library. I would like to make a case that in 1971 a decent computing center for educational purposes is as important an element for undergraduate instruction as a decent library, and that accrediting teams deny accreditation to those schools which fail to provide this service."[11]

Such top level commitment is needed for instructional data processing to be widely employed at an institution. Since the faculty at most institutions control the instructional methods, a top level commitment must be made to develop a faculty that is sympathetic to instructional data processing. Without this overt commitment, instructional use of the computer will probably be sporadic and follow disciplinary lines. The instructional methods chosen by the faculty will be based on their experiences in graduate school, other institutions, and through contact with colleagues, rather than through a consideration of how other courses are being taught on campus. Thus, without the pressure of top level commitment, the only conscious consideration given to the employment of instructional data processing will be that given by department chairmen who are sympathetic to the concept, as they assemble their staffs.

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[10] Jack A. Chambers, etal., Computer Networking: Experimentation in Higher Education, Computer Research Center, University of South Florida, Tampa, Research Report No. 71-1.

[11] As quoted from a speech to the Conference on Computers, June 23, 1971, in the "CAI Reporter," Volume I, Number 10, July 12, 1971.

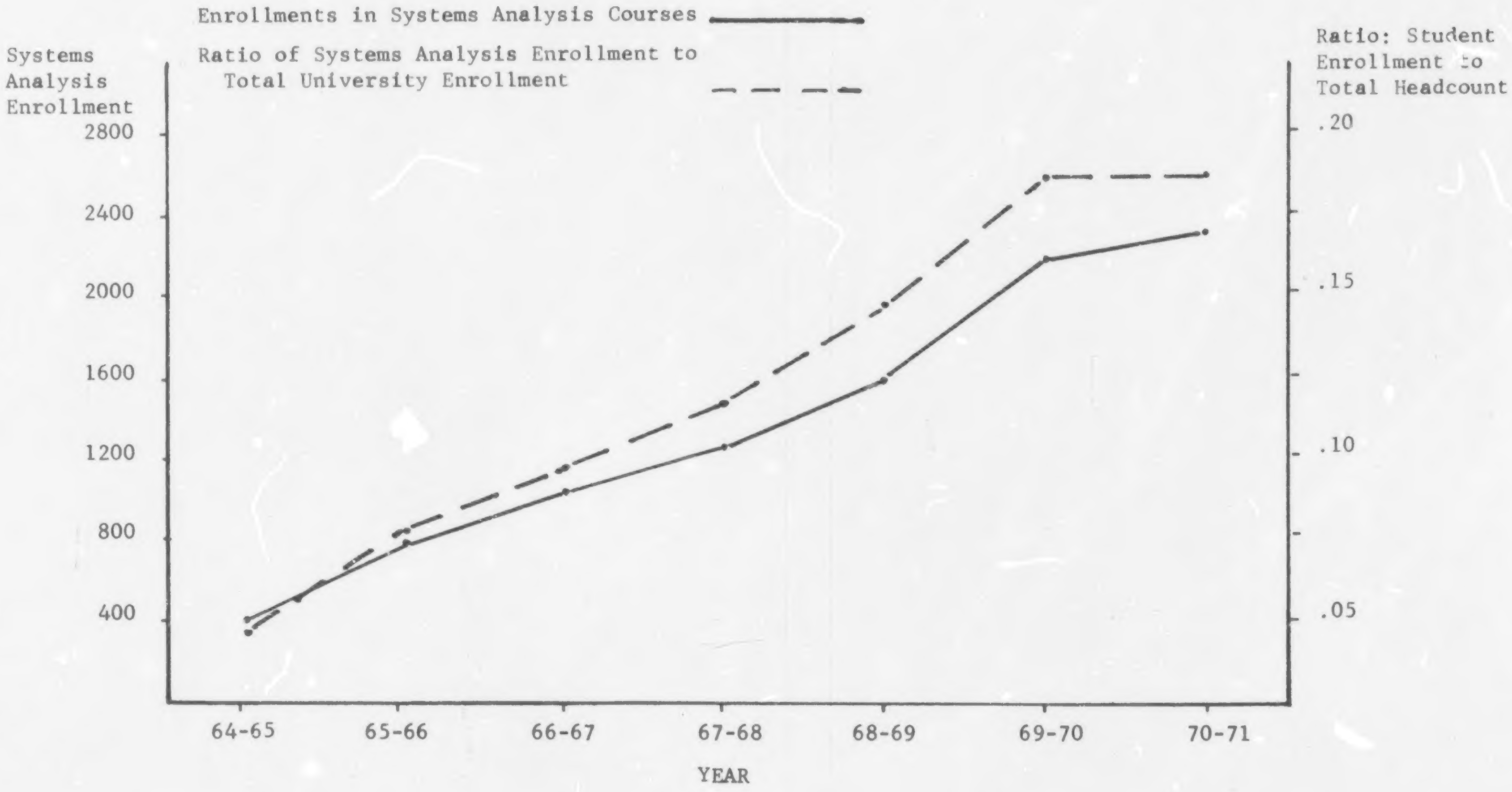
Such a department has grown at Miami University (of Ohio). Begun in 1964-65, the Systems Analysis Department has grown from serving 439 students to serving 2383 in 1970-71 -- a 32% annual compound rate of growth. In that time, the ratio of students served to institutional headcount has increased from .05 to .19 (see Figure 10).

A case history is given in Appendix J of Coast Community College, an institution where a conscious decision was made by the Chancellor and Trustees to make a major investment in instructional data processing. Implementation of this decision required that access to a computer would be readily available to the students and that development of instructional materials by faculty members would be sponsored. The latter commitment was a recognition that promotion of faculty interests would also promote the desired result -- the use of computers in the instructional process. The emphasis was on development and teaching, rather than some other output and, presumably, this effort was rewarded. The faculty was allowed to maintain a considerable control over what was taught and how the computer was employed in their methodology. Finally, the faculty was allowed to create with the computer rather than be replaced by it.

Perhaps many institutions in Illinois are about to enter a similar situation. The current interest level in the State relative to CAI in general and PLATO in particular is high. Plans call for a demonstration project involving up to 4000 terminals located at universities, colleges,

Figure 10

Growth of Systems Analysis Department
Miami University



junior colleges, and elementary schools to be completed under the auspices of the University of Illinois by 1975. Estimates indicate that beyond 1975 the PLATO system has the potential of providing half of the instruction in at least two-thirds of the junior college programs and could account for twenty-five to fifty percent of the total instruction at a senior college or university.[12] Assuming that the enrollment projections to 1976 as presented in Master Plan-Phase III are realistic and that enrollments at private colleges and universities will maintain their current level, analysis of Table 14 indicates that approximately ten PLATO systems (each providing eight million contact hours of instruction over 4000 terminals), with a total of 40,000 terminals would be required to meet these projections.

TABLE 14

Projected PLATO Instructional Contact Hours (1976)

	1976 ENROLL.	CONTACT HRS/STUDENT/YR	TOTAL CONTACT HRS	PLATO INSTRUCTION	PLATO CONTACT HRS
Public Sr.	191,000	450	85,950,000	.25	21,487,000
Private Sr.	110,000	450	49,500,000	.25	12,375,000
Jr. Colleges	268,000	450	120,600,000	.33	40,200,000
TOTAL	569,000		256,050,000		74,062,000

It is entirely unrealistic to assume that the State could suddenly implement ten PLATO systems immediately after the demonstration project. Ultimate implementation of such systems depends upon the proof of their cost/effectiveness, the acceptance by administration, faculty, and students, the sources of funding, and the management of the service.

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[12] Alpert, Daniel, "Implementation of PLATO IV as an Instructional Delivery System for Higher Education in the State of Illinois," unpublished paper presented to the Technical Advisory Committee to the Committee on New Institutions of the Illinois Board of Higher Education, August, 1971.

Hopefully, the demonstration project will provide this proof. The design of the project is such that an evaluation of the effectiveness of the education service delivered by PLATO will be compared to that delivered by the traditional modes of instruction. To this point in time, most evaluations have been anecdotal. From a research point of view it has been difficult to assess the impact of computer aided instruction. Improved student performance may be as much the result of intense faculty interest in teaching as it is in the development and use of CAI materials. It may also be that the development of CAI meterials has resulted in the development of better instructional materials and methodology in general.

Because of these considerations, it is imperative that the Board of Higher Education be in a position to interpret the results of the demonstration project relative to CAI's educational impact and possible statewide implementation (at an estimated cost of $135 to $150 million).

Summary. Computers are having an accelerating impact in our everyday life. Without them, we would be unable to achieve the complex technological environment in which we live. It is estimated that computers and computer related activities account for approximately twelve to fifteen billion dollars per year. It is forecast that the volume of this business will increase at a rate varying from 15% to 35% per year.

This national increase in the use of computers is relevant to the plan for uses of computers in Illinois higher education. There will be an urgent need for computer educated and computer trained people in all walks of life. There is an even greater need to make the general public aware of the nature and application of computers. Dr. Edward David, Jr., Science

Advisor to President Nixon, has remarked that we face the challenge of "converting the image of computers from the image of an unwelcome intruder -- a disagreeable agent of change, to the image of a benevolent helper and resource for our country."[13] To do this, a commitment must be made to use computers as a device in the teaching process, to teach teachers, to teach other disciplines, and to teach the general public.

Research Demand for Computing Services

The Research Subcommittee's report presented a concise and well interpreted response to their charge of estimating the computer resources presently used in support of research activity in Illinois colleges and universities. Because of lack of cooperation from the private universities, their report had to be limited to the public universities and colleges.

The subcommittee constructed a factor to give the effective computer power of each machine in the public university system in terms of a "Standard" computer (the IBM 360/75 configuration at University of Illinois Urbana). Based on the analysis of one of the questionnaires distributed by the Board of Higher Education, Tables 15 through 19 were constructed. The subcommittee summarized the status of research computing by the following statements as quoted directly from their report:

1. "About 95% of all research computing in the State system occurs on the nine campuses of the State universities, a set we shall refer to as LRU (large research users).
2. "Considering the LRU schools only, 91% of the research computing occurs on the three campuses of the University of Illinois.

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[13] Edward E. David, Jr., "Computers and the Nation," Computers and Automation, p. 14, (September, 1971).

3. "The largest single contribution to the LRU comes from a group of Dedicated Computing Facilities (DCF's) located on the Urbana campus of the University of Illinois. This group includes ten large computers, ranging in size from a CDC 1604 to a Burroughs B6700. Their total usage accounts for 68% of the total from the LRU schools. The DCF's are largely supported by grants and contracts with federal agencies.

4. "In terms of computing power, the total university research load is equivalent to the full-time operating of about three IBM 360/75's. (It is actually carried out on installed capacity equal to about six IBM 360/75's, but many of these computers are used for other purposes in addition to research computation.)"

TABLE 15

RESEARCH USAGE ON PUBLIC UNIVERSITY COMPUTERS (Excluding Facilities Listed in Table 16)

Institution	Machine	Hrs/Mo	Factor*	Equivalent Usage	Subtotals
University of Illinois					
. Urbana	360/75	345	1.0	345.0	
	360/20	357	0.02	7.14	
. Chicago Circle	360/65**	123	0.4	49.2	
	1800	80	0.02	1.6	
. Medical Center	360/44**	255	0.06	15.3	418.2
Northern Illinois Univ.	360/67	187	0.4	74.8	74.8
Southern Illinois Univ.					
. Carbondale	360/65	163	0.38	61.9	
	1130	55	0.02	1.1	
. Edwardsville	360/40	85	0.04	3.4	66.4
Illinois State Univ.	360/50***	68	0.12	8.16	
	360/40	30	0.04	1.2	9.36
Eastern Illinois Univ.	360/50	60	0.12	7.2	7.2
Western Illinois Univ.	360/50	50	0.08	4.0	4.0
		Effective Installed Capacity	= 2.70	Effective Use	= 580.0

* Effective computer power of each computer in terms of IBM 360/75 equivalence

** Recently replaced by IBM 370/155

*** IBM 360/40 replaced with IBM 360/50

By definition: One (1) month full-time operation = 24 x 6 x 4.29 = 618 hrs/mo. The number of full-time equivalent 360/75's = 580.0 ÷ 618 = 0.94.

TABLE 16

RESEARCH USAGE ON DEDICATED COMPUTING FACILITIES AT THE URBANA-CHAMPAIGN CAMPUS OF THE UNIVERSITY OF ILLINOIS

Project	Machine	Hrs/Mo	Factor*	Equipment Usage	Subtotals
ILLIAC IV	B6700	600	0.7	420.0	420.0
PLATO	6400	320	1.0	320.0	
	1604	320	0.08	25.6	345.6
High Energy Physics	7094/1401	200	0.4	80.0	
	CSX1/1401	720	0.1	72.0	152.0
Civil Engineering	B5500	450	0.33	150.0	150.0
Materials Research Lab.	Sigma 5	350	0.3	105.0	105.0
Coordinating Science Lab.	1604	375	0.08	30.0	30.0
Electrical Engineering	CDC G205 (2)	130	0.2	26.0	26.0

Effective Installed Capacity = 3.19 Effective Use = 1,228.6

By definition: One (1) month full-time operation = 24 x 6 x 4.29 = 618 hrs/mo
The number of full-time equivalent 360/75's = 1,228.6 ÷ 618 = 1.99

*Effective computer power of each computer in terms of IBM 360/75 equivalence

TABLE 17

SUMMARY OF TOTAL PUBLIC UNIVERSITY RESEARCH USAGE

A. Institutional Facilities

	Equivalent Usage	% Institutional Usage	% State Usage
University of Illinois			
. Urbana	352.14	60.7	19.5
. Chicago Circle	50.8	8.8	2.8
. Medical Center	15.3	2.6	0.8
(Univ. of Illinois - Total)	(418.2)	(72.1)	(23.1)
Northern Illinois University	74.8	12.9	4.1
Southern Illinois University			
. Carbondale	63.0	10.9	3.5
. Edwardsville	3.4	0.6	0.2
(Southern Ill. U. - Total)	(66.4)	(11.5)	(3.7)
Illinois State University	9.4	1.6	0.5
Eastern Illinois University	7.2	1.2	0.4
Western Illinois University	4.0	0.7	0.2
Total - All Institutional Facil.	580.0	100.0	32.0

B. Dedicated Computing Facilities (DCF)

	Equivalent Usage	% DCF Usage	% State Usage
ILLIAC IV	420.0	34.2	23.2
PLATO	345.6	28.1	19.1
High Energy Physics	152.0	12.4	8.4
Civil Engineering	150.0	12.2	8.3
Materials Research Lab.	105.0	8.6	5.8
Coordinated Science Lab.	30.0	2.4	1.7
Electrical Engineering	26.0	2.1	1.4
Total - All DCF	1,228.6	100.0	67.9
Grand Total - All State Research	1,808		100.0

TABLE 18

COST EFFECTIVENESS OF RESEARCH USAGE ON COMPUTERS LISTED IN TABLE 15
(Note: All Fiscal Data Expressed in Thousands of Dollars)

Institution	Hardware Costs Capital	Hardware Costs Lease	Reported Total Institut. Funds for Computing	Reported Total Contract Funds	Prorated Institut. Funds for Research	Annual Costs of Research Computing	Equivalent Usage (from Table 15)	Effective Cost/Hour (Equivalent to 360/75)
University of Illinois . Urbana	$ 0	$ 999	$1350	$550	$ 400	$ 950	345.0	$ 230
. Chicago Circle	0	359	721	73	221	294	50.8	482
. Medical Center	40	90	355	25	203	228	15.3	1240
Northern Illinois Univ.	5	389	1585	7	471	478	74.8	530
Southern Illinois Univ. . Carbondale	140	408	1592	0	438	438	63.0	579
. Edwardsville	0	180	569	0	114	114	3.4	2800
Illinois State Univ.	0	299	869	0	156	156	9.4	1380
Eastern Illinois Univ.	0	337	648	0	65	65	7.2	750
Western Illinois Univ.	0	200	457	0	50	50	4.0	1040
TOTAL	$185	$3261	$8146	$655 (24%)	$2118 (76%)	$2773	572.9	

Average Effective Cost/Hr. = $ 403

*For those campuses reporting partial contract support (which covers only research computing), the institutional funds assignable to research computing (I_r) were prorated according to the relation:

$$I_r = fI - (1 - f)C$$

where I = total annual institutional funding

C = total annual contract funding

f = fraction of facility devoted to research computation

The annual cost of research computing is then the sum ($I_r + C$). The equivalent cost per hour is given by

$$\frac{(I_r + C)}{12U}$$

where U is the equivalent usage factor (per month) from Table 15 and the factor 12 puts the annual cost on a monthly basis. The resulting values are in the extreme right-hand column.

These data do not give the actual cost/hr of research computing at the individual facilities. They provide an estimate of the cost of a fixed unit of computing work. Stated in other words, the effective cost/hour for institution X is the approximate cost to perform on institution X's computing facility an amount of work which could be done in one hour for $230 at the University of Illinois, Urbana Campus, IBM 360/75.

TABLE 19

COST EFFECTIVENESS OF RESEARCH USAGE ON COMPUTERS LISTED IN TABLE 16
(Note: All Fiscal Data Expressed in Thousands of Dollars)

Facility	Institutional Funds	Contract Funds	Annual Costs of Research Computing	Usage (from Table 16)	Effective Cost/Hour (Equivalent to 360/75)	Basis of Hardware Acquisition
ILLIAC IV	$ 0	$636	$ 636	420	$125.80	Leased with Federal funds; $360,000/year.
PLATO	300	407	707	346	$170.00	CDC 6400 - leased with State and Federal funds; $700,000/year.
High Energy Physics	0	142	142	152	$ 77.50	Ten (10) year fully amortized machine, owned by University of Illinois; acquired with NSF funds, IBM discount, and institutional funds.
Civil Engineering	0	195	195	150	$108.30	Installment - purchase plan; $123,000/year.
Materials Research Lab.	65	17	82	105	$ 65.00	Purchased with Federal funds.
Coordinated Sciences Lab.	0	50	50	30	$139.20	Purchased with Federal funds.
Electrical Engineering	36	55	91	26	$291.70	Purchased with Federal funds.
	$401 (21%)	$1502 (79%)	$1903	1229		

Average effective cost/hr. = $129

Further analysis of Table 17 indicates that the Urbana campus of the University of Illinois accounts for 87% of the research computing in the State's public senior universities. Such findings might seem to indicate that there are no "statewide" problems or issues in research computing. This is not the case, however. Two such issues are the provision of cost/effective research computing for the other campuses and a policy on Dedicated Computing Facilities (DCF).

Cost/Effective Provision of Research Computing Resources. The State of Illinois recognizes no explicit commitment to the support of general academic research. However, analysis of Tables 18 and 19 indicates that there is substantial implicit support for such activities. Summarizing these tables below, it can be seen that State and institutional funds support 54% of the research computing statewide and that at campuses other than Urbana, such funds account for 94% of the support.

	URBANA		OTHER		STATEWIDE	
	DOLLARS	%	DOLLARS	%	DOLLARS	%
Contract	2,052,000	72	105,000	6	2,157,000	46
State and Institutional	801,000	28	1,718,000	94	2,519,000	54
TOTAL	2,853,000	100	1,823,000	100	4,676,000	100

The method for the provision of this general support is different than that of the contract funded research. Research contracts are negotiated between the principal investigator and the program officer at the granting agency and are normally project oriented. General support, however, is determined by institutional discretion, and in many cases involves the dual goals of research achievement and graduate student training.

With the possible exception of the Medical Center Campus at the University of Illinois, it is not expected that the percentage distribution of contract research between Urbana and the other schools will change. The reason for Urbana's dominance is the number of strong research groups located there. It is expected that Federal monies, at least, will go to those institutions with proven records of performance.

It appears then, that implicit support of research uses of computers will probably continue. Such institutional discretion, however, should not be allowed to ignore the potential of efficient resource sharing made possible by advances in computer technology. Analysis of the data in Table 18 indicates the inefficiencies of local campus operation of small research computers. Differences in the effective cost per hour of 2.5 to 12 times the equivalent cost of operation on the Computer Services Office computer at Urbana are indicated. Beyond this, the resources required, not only in hardware, but in software and data bases are typically not available locally. To avoid these economic and resource deficiencies in the future, attention should be given to determining the possibilities of linking other public and private universities into the University of Illinois at Urbana and perhaps into the ARPA network (described elsewhere in this report) where the research at these universities warrants it.

Policy on Dedicated Computing Facilities (DCF). The Dedicated Computing Facilities (DCF) referred to by the subcommittee can be defined as a facility serving a specific user or group of users. DCF's are typically used when they are required to support a specific research project. For example, ILLIAC IV was constructed as an object of research and the CDC 6400 was chosen as the DCF for the PLATO project, since specialized hardware and software were necessary for this CAI application.

As can be noted in comparing Tables 18 and 19, DCF's have lower effective operating costs than do the research computers which are also used for other institutional computing. This results from lower software costs due to the lack of a requirement for handling general clientele on the computer and lower hardware costs because the computer is normally wholly owned as the result of a research grant from outside agencies.

DCF's become an issue not because they are required for a specific task, but because they frequently become competitive with the campus computing center for general computing support or because they require funding by the institution beyond the basic research project. They normally are outside the control of institutional or state agencies, yet can severely impact local computing capability. For this reason, some states require approval of a DCF (the State University System in California), or place restrictions on its use (Colorado). DCF's typically cannot be used to meet State needs since their priorities do not assure any specific level of service or continuity of operation.

A State policy on DCF's should then: (a) provide for installation and operations of DCF's when they have no impact on other facilities, and (b) protect users and institutions from the long-term effects of short-term projects. Specifically, it is proposed to the Board of Higher Education that they strongly suggest the following policies to the governing boards for their consideration and adoption.

.. DCF's can be established whenever the entire cost of the facility is borne by the research project and the institution, governing boards and State incurs no obligation for equipment or personnel

> beyond the period of the contract. This does not preclude long term contracts, but all such contracts must include cancellation clauses if funds for the project become unavailable. Further, the facility must be justified solely on the basis of the project and not by providing an additional general computing service to the institution or the State.

There will be, however, instances where it is in the best interests of the State for an institution to have a Dedicated Computing Facility even though there is impact on other installations. For example, if the equipment would be useful to the State, it may be desirable to incur a long-term obligation for the equipment with the understanding that the equipment will be used by the State. This can be accommodated by a three-way agreement:

.. The equipment for a Dedicated Computing Facility can be procured either by purchase or lease-purchase arrangements which extend beyond the project grants when it can be utilized at some later date by another institution or agency in the State. Such procurements require contracts at the time of initial procurement between the vendor, and the "initial-use" and "end-use" institutions and agencies which:

a) places responsibility for later use and payment for the equipment with the "end-use" agency or institution;

b) provides a cancellation without penalty clause should the "end-use" agency not have the funds or authority to accept the equipment at the time it becomes available;

c) sets a date-certain for transfer of the equipment from the "initial-use" institution or agency to the "end-use" institution or agency, although provisions should be made for a change in date upon mutual agreement.

This type of agreement protects the "end-user" both in terms of cost and date of availability. While it obligates the "end-user" to equipment procurement, it permits the institutions and State to take advantage of any savings which may occur through long-term lease, lease-purchase, or purchase of equipment for other purposes.

A much more difficult set of circumstances occurs when a Dedicated Computing Facility can offer competing services to the general institutional computing facilities. The operation of a DCF can then severely impact the central installation by making computing a "free good" or, through the subsidy of the research project, offer rates much lower than the central facility. Since the DCF has no responsibility for long-term service, short-term operation of the DCF for general computing could make the central facility not viable for the long term. The appropriate action appears to be to have the general computing facility operate, or "wholesale" the DCF capability in such a way as to preserve the general facility's long term capability. This would provide:

> .. A Dedicated Computing Facility which offers general computing services, in addition to its fundamental purpose can be established when its general services are provided under the direction and control of the general computing facility, and provided that the agreement for exercising this control and joint operation is fully described to all parties before the DCF is established and wherever possible, included in contracts between the parties.

But, there will be situations in which DCF's are the best interest of the institution or the State, impact the general computing facility, yet are beyond the control of the general computing facility, and may incur a long-term obligation. These situations suggest an exception be included in the policy such as:

> .. In addition, a Dedicated Computing Facility can be approved and established provided that it can be demonstrated through cost-effectiveness analysis that it is in the best interests

> of the State, it is approved by the governing board of the institution and that board accepts the fiscal responsibility for the installation, the cost justification, and any subsequent expenses for conversion or compatibility efforts which may be required to accommodate to a State plan for data processing, that appropriate implementing policies and procedures be adopted by the governing board, and that the DCF be approved by the State Board of Higher Education and the Management Information Division of the Department of Finance.

This policy is specifically designed to protect the State from having to accommodate its planning to decisions made by institutions and governing boards which may be uneconomic for the State as a whole. Note that the primary criteria is the interests of the State; thus, the State has the opportunity to approve the installation in the broader context of all public higher education. Frequently a decision which is best in the local environment is not optimum in a larger context.

Administrative Demands for Computing Service

Current Situation. Before the incorporation of computers in administrative data processing, life was probably a lot simpler (and happier) for those administrators responsible for the detailed day-to-day work in processing student and staff records, accounting and financial transactions, and in general, for keeping the university alive and growing. They had control over their assigned areas and had direct control over paper flow in and out of their departments. They also had direct custody and control over all data files and the policies and procedures relating to their analysis. Little "total university" or "cross-departmental" analysis could be done. In short, they could chart their own destiny.

The introduction of the computer altered all this. Gradually, each department manager found himself dealing with a new "computer professional" or the old "tab shop" personnel who assumed this role. Frequently, the pressure existed to employ the computer in the departments operations to provide better service and more information at lower costs.

Thus, the age of computerization began in earnest in the late fifties and early sixties and progressed rapidly. This computerization was characterized by the fact that each department's work was converted intact, generally using much the same procedures that existed prior to computerization. In retrospect, it would have been much better had these procedures been changed to take full advantage of the possibilities of integrated systems offered by the computer. Instead, this conversion process created a multiplicity of systems and sub-systems which were incapable of being integrated and which were dependent for operation upon a particular vendor's computer and the person creating the system. Thus, users lost control of their files and what was happening to those files, despite the fact that they were still responsible for keeping the records updated and for providing information to university administrators. They were now dependent on computer technicians to accomplish this work for them. It also became increasingly difficult to make changes to the system since these changes had to be made through technicians who were already overburdened. Getting a new report produced, even from existing files, sometimes took months. The framework was set for continuing internal skirmishes between user and computer technicians and this situation continues essentially unaltered, to the present time.

As a result of these past activities the following observations can be made about the current university ADP situation:

1. It is fragmented. Data elements such as student name or social security number, as examples, are stored in numerous files and are a necessary part of a number of different administrative applications. Institutions are finding, as they begin to have a large number of computer programs, that maintenance becomes a significant factor since each change in the data base (or file structure) can require changing a large number of computer programs. These programs have to be both modified and tested, absorbing a significant amount of programmer resources and computer time. Thus as institutions have increased the number of data processing applications, they have discovered that an increasing amount of the resources are being spent merely to maintain the current level, and further development is impossible to sustain.

2. It contains a large amount of duplication (some of which is necessary and some that is not). Since university operations are everywhere generally the same, each has developed its own version of, say, a student record system complete with tailor-made input and reports. But since institutional policies differ on, for example, student admission and registration or accounting policies, it becomes a complex matter to determine which applications have enough commonality to be considered as part of an effort to begin eliminating some of this unnecessary duplication; or for that matter to attempt to define what is necessary duplication and what is unnecessary. Appendix K contains a list of typical university ADP applications. While this issue has been left unresolved by the Task Force, there appear to be significant economies to be achieved by cooperative or central development of administrative software. This will probably be achieved in the future because of the long-run efforts of the universities, their governing boards, and national projects like WICHE-NCHEMS and CAUSE. At the present time, however, neither commercial enterprises nor sponsored developmental projects have produced software packages which are widely used.

3. There is a large current and continuing investment in ADP software development. A previous section on funds demand showed that universities are

spending over half of their funds on ADP ($45.00 per student out of a total of $85.00 per student). In FY72 this amounts to over $7.6 million. If we can assume that the annual investment in programmers and systems analysts dedicated to ADP roughly approximates the annual investment in ADP software development and maintenance, then we can estimate the size of these expenditures. These data were reported to the Board of Higher Education by the universities and equal $1.922 million for FY72 for 187 positions. This estimate does include some systems positions that are probably not doing application work, however, it also omits management, clerical, and statistical personnel and programmers and analysts who were outside computer centers. Overall, the estimate must be considered a conservative one. Additionally, it was discovered in the technical audit that computer usage for testing ADP programs runs from 30 percent to over 50 percent of the total ADP computer usage at individual installations. In hardware costs this represented an annual cost of over $1.221 million. So the total annual investment in ADP development is estimated at over $3.1 million. This is 40 percent of the total ADP costs and 22 percent of total computer costs. New approaches are needed immediately to curb the magnitude and growth of ADP software development costs.

4. ADP systems are not responsive to user needs. This can be documented in the year end annual reports of a number of institutions. These reports are prepared by independent national CPA firms and their comments about university administrative operations are evidence of the costly fragmentation of data systems. In fact, such comments about one of the major universities said that data system had reached such a state that it was nearly impossible to obtain new reports and information from existing systems in a cost effective manner, and a major overhaul of these systems to make them more responsive was recommended. The Task Force believes there is a growing desire by university managers to acquire or develop MIS and DMS systems. (Attached as Appendix L is a detailed discussion of DMS systems by R. L. Martino) but the real question is one of costs. While the institutions admit that current systems are not completely responsive to their needs, they have invested millions in their development and are

> reluctant to scrap them for a relatively untried DMS system which may be expensive to implement. Besides, any one institution cannot afford these development and implementation costs. However, through cooperative efforts and pooling of resources, all universities in the State should have this capability.

The Report of the ADP Subcommittee. The ADP Subcommittee was one of a system of committees comprised of university computer experts who assisted the Board of Higher Education in the early stages of this project. Their charge was to develop a statement of long range ADP computer needs and suggest new approaches for fulfilling these needs. Their report, "Preliminary Report For A Statewide Plan For Administrative Computing in Higher Education" was perhaps the most comprehensive report developed by any of the committees working on this project. This report was an important contribution to the development of a State plan because:

1. It documented in precise detail the uniqueness of ADP as opposed to other types of university computing.
2. It described the range of ADP services that are offered at most universities.
3. It defined problems associated with doing an analysis of university ADP.
4. It developed alternative approaches for providing ADP services and evaluated each using a pre-established set of performance criteria.
5. It supported IMPACT 70's recommendation calling for cooperation between State government and universities.
6. It recommended a Computing Resource Agency (CRA) be established to coordinate, control development and provide resource groups to assist ADP services in Illinois higher education.

The Subcommittee's recommendation of the establishment of a CRA was a good one, despite charges that such an agency could not be effective. A statewide agency of this kind needs to be established to effectively coordinate all university ADP activities. However, the vital missing link in the recommendation is the line authority necessary to accomplish coordination. Presently this line authority is vested in the separate governing boards. It would seem reasonable that any new statewide agency such as CRA would have to be controlled by institutional and/or governing board representatives who would be in a position to delegate management authority for operation of the agency. Further, the line authority needs to include, in addition to the powers listed by the Subcommittee, the following:

.. statewide ADP hardware control and planning,
.. statewide ADP software development control, and
.. statewide ADP information standards control.

While the report provided guidance and essential qualitative information describing ADP, it came up short on a number of counts:

1. It failed to isolate the costs of ADP. This was primarily a problem outside the control of the Subcommittee and having to do with inadequate data collection techniques.

2. It did not face the critical issues of how to solve the duplication and fragmentation existing in current data systems.

3. It ignored, almost completely, the need for Data Management System as discussed in IMPACT 70's.

Probably the biggest reason for the Subcommittee failing to face these important issues is the fact that it was composed wholly of ADP technicians and professionals. Their perspective and lack of authority to make binding decisions and commitments prevented them from suggesting bold actions or new innovative approaches in solving the ADP problems listed above. This would require them to change their own ADP operations.

Regardless of these shortcomings, the long range impact of the report is:

- .. To emphasize that cost effective management techniques can be applied to ADP in higher education.
- .. To stress that sharing of all ADP computer resources is essential among institutions.
- .. To demonstrate that State agencies, higher education planners, and members of the legislature are interested in solving currently existing ADP problems.

Future Plans For Public University ADP. Each university was asked to develop a five year plan showing the types of ADP development work each will be doing from FY72 to FY77. Prior to this request, very few of the universities did any formal long range planning except during annual budget cycles. An analysis of these plans shows that millions of dollars in development effort is being scheduled and that this development appears to be strikingly similar. Following are the general trends that can be expected in university ADP development:

1. The bulk of the effort, as much as 60%, will be concentrated in modifying existing batch systems to increase efficiency and capability to meet increasing work volumes and changing needs.
2. The development of new systems will require up to 40% of existing resources.
3. Schools with large scale computer systems are modifying current systems to provide on-line display and updating.
4. A small number of schools are moving to integrate existing data bases and this effort will become more widespread.
5. Some schools are moving to implement the WICHE-NCHEMS program products and some, not content with these products, are developing their own.

These are primarily PPB oriented software products for resource allocation. All schools are active in this area.

6. An increasing amount of activity associated with Computer Output to Microfilm (COM) and scanning applications.

7. Only slight activity in the implementation of ADP vendor supplied program products. Hardly any of the schools find packages that are currently suitable for their institution.

8. In the Board of Governors system there will be increased activity as those institutions continue to develop their Compatible Information System (CIS) project under the auspices of the Board of Governors central office. The ultimate goal is to develop standard ADP applications systems driven by uniform and compatible data bases.

A summary of these plans hardly represents an encouraging picture for the State and the impact these plans have on State funding sources. It is clear that this continuing "re-invention" must be controlled, but in order to do that certain State standards must be developed:

1. Data Element Standards -- uniform data element dictionaries must be developed.

2. Software Development Standards -- central development, where appropriate, must be begun to head off continuing duplication.

3. Information Reporting Standards are necessary.

4. Application Package Standards.

If we are to bring any semblance of order and economy to our massive data problems, then statewide leadership either on behalf of State agencies or the institutions -- or both -- is needed immediately.

Computer Networks

There are indications that there will be a significant change in the manner in which computers will be utilized in the future. Up to the present time, to a large extent, computer utilization was based upon a single system. As organizations became larger, and as their data processing load increased, larger scale systems were installed. There seems to be a shift away from this concept, towards the idea of sharing of services, with more economy being achieved through the use of a rich resource shared among a number of users. There is a significant move away from the single computer installed in a single department or in a single organization to the concept of a shared network used by a number of departments or organizations. As a result, the number of large scale installations should increase, the number of terminals, especially those with some kind of computer or data processing capability should also increase, and the number of medium sized machines in the center of this range should dramatically decrease as a percentage of the total computer complement. Furthermore, information services will rapidly accelerate as a component of the total computer market.

This movement has already been observed in higher education. It is no longer a research question of "will it work?" Computer sharing is being demonstrated in at least thirty-six educational networks in the country.[14]

Two purposes for networks can be discerned in higher education. The first purpose emphasizes resource sharing where the on-campus computing load is sent to another location to obtain a variety of services unavailable locally. The second purpose emphasizes cost reduction. The computing load at one campus is sent to another location via telecommunication lines in order that more economical service might be provided.

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[14] Jack A. Chambers, etal, "Computer Networking: Experimentation in Higher Education, Computer Research Center, University of Southern Florida," Research Report No. 71.

Several networks have particular relevance to the future computer situation in Illinois higher education. A description of the most significant of these follows.

Triangle Universities Computing Center (TUCC). Formed in 1966, TUCC is a private, not-for-profit corporation owned by Duke University, North Carolina State University, and the University of North Carolina at Chapel Hill. TUCC can accurately be described as a wholesaler of computer time to its three owner institutions, the North Carolina Educational Computing Service (NCECS), and other customers such as the North Carolina Science and Technology Research Center and the Research Triangle Institute. Forty-four higher educational institutions with a 1970 fall headcount enrollment of 104,000 students are served. Policy is set by the TUCC Board of Directors which consists of three representatives from each of the owner schools. The Board sets policy within which the staff operates. The campus computing center directors of the three owner institutions form a technical advisory body to the President of TUCC.

Campus centers at the owner institutions can be regarded as retailers of computer time and services. Even though they all pay the same cost per hour to TUCC, their charges to their campus users varies. This allows the campus center to use its profit over the TUCC charges to build its own staff and services.

TUCC's staff consists of approximately ten administrative and clerical personnel, seven systems programmers, and eight operators. No user applications are developed. These are all developed at the owner installations. The owner installations staffs vary from about thirty to fifty people. In addition to administrative and clerical personnel, these staffs are mainly applications programmers and user consultants.

The North Carolina Educational Computing Service (NCECS) is an agency of the Board of Higher Education. TUCC wholesales computer time to NCECS. NCECS agrees to purchase at least a minimum amount of computer time annually. They, in turn, retail these hours to the participating institutions. The Director of NCECS is, in effect, the participating school s agent in relation to TUCC.

NCECS is much more than a time broker. They are an educational service organization for curriculum development. They have made available outside developed packages to the participating institutions as teaching units. Currently, they have collected approximately 7000 programs, have loaded seventy-seven on the system, and have forty-four fully documented for use. In addition to providing packages, NCECS holds workshops and seminars on the use of these packages and other items of interest. NCECS serves public and private colleges, junior colleges, technical institutes and secondary schools.

As with the TUCC owner institutions, the NCECS participating institutions pay for the agency's educational services. The total billing includes both computing time and the overhead charges necessary to support the NCECS staff and educational services provided. The staff consists of eight persons supported by participating institutions and 1.5 FTE supported under outside grants. The participating institutions agree to purchase services at the established rate for one year. No difference in charging is made to public as opposed to private educational institutions nor by level of institution.

New Jersey Educational Computer Center (ECC). In New Jersey a public, not-for-profit corporation has been established to provide computer related services to the state's public and private colleges. The Board of Directors consists of nineteen members representing the Association of Independent Colleges and Universities, the Cooperative Central Planning Group of Public Higher Education in Newark, the Council of State Colleges, the Council of County Colleges, the Chancellor of Higher Education, Rutgers University, and the public.

The network uses three large scale computers which were installed at Princeton and Rutgers prior to the formation of the corporation. More than twenty institutions, including five private colleges are to receive services. Resource sharing of the large scale computers by the smaller institutions is one emphasis, but cost savings is another. Systems development is being contracted by the corporation with savings of thousands of dollars being reported:

> "Trenton State's use of the Princeton computer (before 'transferring' to Rutgers) and a state-developed student information system provided the first dramatic proof of the potential of the ECC system. The college saved $100,000 in faculty salaries, and gave students a greater scheduling choice, both with professors and class times.
>
> "While the scheduling system was written at a one-time cost of $140,000, it can be used by other colleges, officials pointed out. The $100,000 saving was achieved by advance knowledge of what faculty staffing would be necessary."[15]

The California State University Network. Under the auspices of the governing board of the recently re-named California State University System (formerly the California State Colleges), a network was established in 1969 to serve the nineteen college campuses. This network, serving a student population of approximately 288,000, utilizes two regional centers with computers at each campus connected via telecommunications lines. Thus, it is a distributed computer network, designed such that 80 to 90% of the workload is accommodated at the local campus. The 10 to 20% of the workload that is processed centrally is the high cost portion. The network is also tied to the IBM System 360/91 located at UCLA. This connection provides not only a large sophisticated computer and a wide range of software that would be unavailable otherwise, but also consulting services from sophisticated users and developers resident at UCLA.

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[15] "New Jersey Utility Provides Data Processing to Colleges," Computer World, August 18, 1971, p.6.

A deliberate effort was made to combine instructional, administrative, and research workloads on one network. This was done because prior investigation demonstrated that their respective peaks of activity were complementary. Policy making, planning, and systems software were centralized in a staff at the governing board. This decision has resulted in cost savings through the development of common applications (most notably, common admission and financial reporting), and common software development and maintenance for the identical hardware configurations within the system.

The Commercial Corporations - Chi and Alpha. The Chi Corporation and the Alpha Corporation established by Case-Western Reserve University and Southern Methodist University respectively, are two profit making corporations designed to provide computer and computer related services to their universities, other educational institutions, private enterprises, and the government. Both, to varying extents, have involved the private sector and the profit motive in establishing the corporation.

The Chi Corporation determined that their existing strength at the university consisted of personnel who had experience running large computing centers. They lacked, however, the management and marketing talents to make a success of a profit-oriented organization. Thus, although the university owns the corporation, the board of directors includes individuals from the private sector, and the president of the corporation was selected on the basis of experience in profit-making organizations.

The Alpha Corporation is owned jointly by SMU foundations, Gulf Insurance Company, and private individuals. Financial assistance is obtained by the sale of debentures to the Gulf Insurance Company, a subsidiary of University Computing Company (UCC). Thus, more capital can be provided than might be generated by the university alone.

SMU's strength was in its faculty. By offering the faculty an equity position in the corporation, it was felt that the faculty could be maintained and strengthened. Thus, the Alpha Consulting Group was established to provide consulting services to other educational institutions and private enterprise. The Corporation provides marketing and management services, and computer time to the consulting group.

Operating procedures differ between the two corporations. The Chi Corporation employs approximately eighty people and operates its computer center off campus. Alpha Corporation employs six to eight professionals excluding the consulting group, and contracts its computer operations to SMU, who in turn, employs about forty people for those operations.

ARPA Network. Currently, there exists a nationwide network which was established through funding by the Advanced Research Projects Agency (ARPA) of the Department of Defense. This network was designed as a resource sharing network. Hardware, software, and data files are currently being shared by the seventeen installations on the network. Any installation can be accessed by any other via an Interface Message Processor (IMP) located locally. Thus, a researcher having access to an IMP can have the benefit of several hardware configurations, software services, and data files located throughout the United States. For example, ILLIAC IV will be part of the network and available for array processing from many points in the United States.

Currently, the ARPA staff manages this network but it is expected that the agency will soon divest itself of this management responsibility. At present, it is not clear who will operate the network in the future. Two possibilities are a commercial common carrier or a not-for-profit corporation.

Implications For The Illinois Plan. The concepts relative to the networks discussed above are presented here because the Task Force feels they are particularly pertinent to the development of a plan for computing services in Illinois higher education. It is hoped that the question of whether networks will work can be dispelled forever. To the Task Force there is no longer a question of whether such networks can be successfully created and operated. The forces of economy and resource sharing have created the networks presented above and many others in business, government, and education. The question becomes, "What can we learn from other's experience in creating networks that will aid in developing a plan for computer services in Illinois higher education?"

One lesson learned is that for a computer services organization to provide the long term stability needed to procure assets and provide acceptable service, it must have legal standing. The California State University System has such standing, since it is a governing board. In other networks, this legal standing was developed by incorporation.

The strength of higher education has been its traditional autonomy in selecting appropriate content and methods of instruction, determining its research program, and achieving an appropriate level of community service. Any organization providing computer services must be able to respond to this requirement for a wide range of services and reflect the changing priorities of the user institutions. For this reason, the service agency should be controlled by the institutions it serves. Voluntary cooperative arrangements cannot provide a sustained response to these requirements because of the lack of authority and responsibility in such arrangements. The corporate form, through representation of the user institutions on its board of directors, can provide the policy directions necessary for the service organization to be responsive to its users.

This leads to a second major lesson learned. The board of directors of any computer services organization is a policy making body. Thus, the inclusion of technical specialists on a board of directors will in all probability be counterproductive to its purposes. ECC is a case in point. Technical representation was allowed at the board level and, in the opinion of the Task Force, has caused some of the implementation problems experienced by this relatively new organization. A more constructive approach is followed at TUCC. The functional areas of instruction, research, and administration are represented on the board of directors while the computer technicians from the owner universities form an advisory group to the TUCC operating staff.

The third lesson for Illinois is that in all likelihood, there will have to be an influx of managerial talent if a statewide computer system is to be developed. Other educational computing services have found that their existing university computer center managers were research rather than production oriented. With a few notable exceptions, there is no reason to believe that this is not the case in Illinois.

Finally, it appears that the greatest benefit to the educational system can be realized in the administrative and instructional systems if the emphasis is on economy, and in the research systems if the emphasis is on resource sharing. The requirements for the encouragement of research computing are a rich mixture of resources in terms of hardware, software, and data bases. The requirements in the instructional and administrative areas are for reliable, user oriented, low unit cost systems which are capable of providing acceptable turn-around time in the face of the immense workloads expected.

CHAPTER V

CRITERIA FOR RECOMMENDATIONS

Conclusions

After interactions with and analysis of papers prepared by the Task Force, the Illinois Universities Consortium for Computer Services was formed to investigate the organizational and operational possibilities for interinstitution cooperation to achieve the quality and variety of computing services required in higher education. Implementation of the necessary arrangements for this cooperation will not be easy. The variety of computer services necessary to support research, the integration of computing services with various instructional schedules and the significant administrative workload currently existent are all impediments to successful implementation of cooperative efforts. Further, while current budget restrictions make it extremely difficult for any single institution to provide all the computer services it requires, these same budget restrictions dictate that any cooperative effort must obtain the best cost-performance increase, minimize the risk of failure, and require a minimum investment before operation.

To accomplish the proposed cooperative use of computer resources, the Task Force has concluded that:

.. Some form of hardware sharing -- a network -- is required.

.. There must be greater emphasis on the instructional aspect and uses of computers.

.. There must be realistic cooperative efforts with regard to the software development and systems planning for administrative data processing areas.

- There must be a reorganization of the posture in which data processing is conducted so that at least consolidation occurs within each institution to the point where one individual is responsible for all computer aspects in that institution.

- There must be active involvement on the part of the most senior management in each institution and system if a plan to meet the requirements of the future in the most cost effective manner is to be implemented.

- There is a requirement to involve senior institutional administrators, faculty members and teachers in primary and secondary education in a very extensive educational program about computers, their capabilities and problems.

- The priorities within the higher education system for the State must be examined, and priorities for computer use must be established which fit within these priorities; in other words, computer utilization must be responsible to the whole educational regime, and not vice versa.

Disadvantages of Cooperative Computing

Economics and Behavior. Before entering into any new commitment for the way computing resources are to be provided in the future, institutional personnel want to be assured that any different allocation of computing resources will be commensurate with the benefits promised. The economics of cooperative use of computer resources, particularly hardware and computing services, can be clearly demonstrated. But in spite of this economic advantage, most computer center staff and many users protest any moves toward centralization or cooperative efforts. It may be useful to consider the source of these concerns since the success of any cooperative effort will ultimately depend upon user satisfaction. There are some underlying economic mechanisms for this behavior if user preferences are considered separately from the economics for all users.

Level of Service. Most users express concern over the resulting level of service and many network users are dissatisfied with their service. There appear to be two reasons: (1) most networks have been developed as a research tool -- the interest was in developing appropriate hardware and software to achieve some theoretical goal -- and (2) networks attract a large number of competitive users. Typically, these networks are unstable; the hardware and software changes frequently and unpredictably, give priority to development over user requirements for production, and are expensive (utilization is typically low and there is a large ongoing investment in hardware and software). The user has justifiable complaints since improved service can be obtained at less cost with his own installation. For these reasons, the regional networks sponsored by the National Science Foundation (NSF) have typically failed after NSF funding was discontinued. This suggests that a network can succeed only if:

- There is long range planning for levels of service, these are communicated to the users, and priority is given to stable, consistent operation rather than use of the network as a research environment for computer scientists.
- There are genuine realized cost savings.
- The level of service, primarily in terms of access and turn-around, are better than the user's previous experience.

It is interesting to note that some users of established networks are dissatisfied even when the network provides faster average turn-around, lower average cost, and improved software capability. These averages fail to identify that, for a small group of users, the level of service will decline. There are typically a number of faculty and students, closely associated with the nascent and growing computer center, who had unlimited access to the computer. These people were quite productive in producing computer programs, frequently concentrating in language development, computer utilities, operating systems, and applications research. Because of the typically underutilized computer facility, access was excellent -- the computer was frequently idle. Thus, networks in attempting to achieve higher utilization, reduce the computer access for these very special users.

Also, large computer networks typically rely more on packaged software. SPSS and the BioMed series of statistical programs are examples of packages used in lieu of local programs; complex operating systems, like OS replace simpler operating systems of which some were locally written, more powerful compilers identify program errors and errors in data which previously were unidentified or ignored; and the expertise is transferred from the local computer center to systems specialists at some remote site. Thus, in terms of access and use, the user has a more powerful, but less responsive computing capability. He is forced to either invest significantly in his "re-education" or reduce his use of the computer.

Because networks typically increase the range of capabilities, they attract many new users. Social scientists, engineers, education specialists, and business majors find the package programs particularly useful. As social scientists begin to use the computer as a tool for analysis, primarily through statistical packages like SPSS (Statistical Programs for the Social Scientist), business students use simulations for problems in production, marketing, economics, and transportation, and engineers use packages for electronic circuit design, structural analysis, and engineering design, the "old" user finds increasing competition for the computing resource. Thus, even large networks like the California State Colleges, find that an increase in capacity by ten-fold and a reduction of turn-around from days to hours still does not satisfy the traditional user. But there are thousands of new users improving their knowledge and skills through computer use.

Availability. To most academic users, computers have been a "free good." There was no charge, no "trade-off" in using the computer. The computer could be used as much as it was available without incurring any economic penalty. However, large installations typically have cost systems accounting for all computer use. If computer resources become constrained, a budget mechanism is imposed or, just public knowledge of the use of the computer suffices as an economic sanction, e.g., the faculty member who uses $25,000 of computer time one month for an urban planning simulation may find the department somewhat less receptive to his request for reader funds, an informal sanction. While the traditional user may have found access to the computer, particularly on weekends or at night, dependent only on knowing the computer center staff, with a network he may find his access dependent upon a judgment of the value of his use of the computer to the objectives of the institution. Thus networks, or centralization, typically inserts some judgment between a user and his access to a computer. While educational institutions typically try to improve access to an instructional resource, in this case networks may re-allocate the resource from the "traditional" few users to a much larger number of more casual users. This suggests that a network can succeed only if:

.. The institution, in transitioning to a network attempts to identify and support all previous users to minimize the loss of access.

.. The network, in marked contrast to traditional federal pricing policies, provides an extremely low rate for marginal use of the computer -- nights, weekends and holidays -- that will encourage rather than prevent access by the dedicated computer user. With a network approaching moderate utliization (say 50%) it should be able to offer rates with 80% to 90% discount from prime shift.

During periods in which funds for higher education are limited, it may be useful to place the "trade-off" between computer resources and other resources, like faculty, before the users. While most computer centers argue for increased funding, when a choice must be made between an increase in computing capability and faculty, frequently institutions will choose not to increase computing. There is no reason why computer centers and computer users should not be made aware that their use of computer resources may significantly impact the availability of other resources to the institution.

Future Demand. For many years administrators and faculty members have predicted massive student demand for computing services, high use of the computer in research, and heavy use for administrative support. Typically these estimates are much higher than the use actually achieved by an institution. There appears to be several factors which delay this "latent demand" from becoming network load. First, there is a training problem for faculty members and other users. Networks have more flexible, and hence more complex, operating systems which require familiarization training. Second, it requires considerable effort to incorporate computing materials into regular instructional materials. There are few generally applicable materials and at this time no means for the instructor to identify materials that are available. Thus, the faculty has to make a significant investment in development or adaptation of materials, which may include restructuring the whole course. Third, for a faculty member whose graduate education is not recent, there may be a basic problem of knowing how the computer is used in the discipline. So far, the faculty member himself is required to keep up with the latest knowledge, yet the computer technology has made major advances in several disciplines in just a few years.

The use of computers in research has been closely correlated to Federal support of research. As Federal funding declined, many principal investigators have elected to reduce computing in order to keep the project staff. Thus, research has become more labor intensive as institutions have struggled to retain qualified staff; this action only intensified the reduction in computing support beyond the general reduction in the support of research.

The high cost of software has prevented many institutions from exploiting the capabilities of computers. These costs reflect the increasing cost of software, both increased labor costs and increased complexity of application programs, and the increasing cost of software maintenance. As most data processing installations have become increasingly aware, having and using a large library of application software requires a significant software maintenance effort. This maintenance effort may come from modifications caused by changes in the application. Whatever the cause, many institutions, particularly those with a number of programs written before the third generation computer (1965) find themselves burdened with program maintenance and unable to direct system development into those administrative areas with potential cost-effectiveness. For networks, then, this suggests:

.. Training will be required for users, particularly faculty members, beyond the current efforts of the local campuses.

.. Projections of future demand should recognize the substitution effect between faculty members and computing, the availability of institutional level training, and constraints on use from lack of software.

.. Cooperative efforts in software development will have a significant impact on the overall cost and utilization of computing facilities.

Summary

There are disadvantages to centralization or cooperative computing for a small, but significant, number of users. Particularly during the transition period, it will be necessary to recognize the needs of this particular group and to provide appropriate services and policies to satisfy those needs insofar as possible. There will always be some users, hopefully a very small number, which will find centralization or network operations reduces access and convenience; a conscientious management will understand, appreciate, and accommodate as many of these users as possible.

Cooperation or consolidation is difficult to accomplish because:

1. There is a need for a State agency or organization charged with the line responsibility to accomplish consolidation. This line responsibility does not currently exist in the institutions, State agencies, or the Board of Higher Education. It does exist in the four governing boards within the system, but their fragmented nature does not allow for any practical implementation.

2. There must exist a technically feasible alternative for establishing the capacity and capabilities to provide acceptable service with reasonable response times. None currently exists although such an alternative is recommended as part of this report. Such an alternative must overcome the fears expressed by each institution as to the successful outcome of any such proposed venture.

3. Procedures and standards must be established to achieve the cooperative effort. None currently exist.

Criteria

While there exists a wide variety of consolidation models to analyze, some of which have been described earlier in this report, the Task Force has studied examples of all of them and has developed a set of criteria as the basis for reaching their recommendation:

.. The alternative must not be precedent setting -- it must be based on currently existing technology that has been demonstrated to work. It is not our intention "to be first in our block."

.. The alternative must have the long run (1972-80) capability and capacity to effectively provide for both current and future computing needs as perceived by both the institutions and the Board of Higher Education.

.. The alternative must minimize both the long run cost of computing per student and the long run risk of failure.

.. The alternative must demonstrate "transition feasibility" -- that the transition to the consolidation of computer resources is gradual and that it can be demonstrated to the institutions, as the ultimate users, that it will have a high probability of success.

.. The alternative will enhance the long range quality of instruction and that students, faculty, and administrators will be directly benefitted.

With these criteria in mind, it was the Task Force's job to select an alternative consolidation scheme that would allow the satisfaction of large future university computing needs within the framework of only very gradual increases to expected State funds.

CHAPTER VI

RECOMMENDATIONS

Analysis of Alternatives

The Task Force has considered a number of alternatives toward organizing to implement a statewide plan for computer resources. The major alternatives are:

- .. Placing all computer operations under a State agency -- either existing or newly created.
- .. Placing all operations under an executive staff reporting to the Board of Higher Education.
- .. Placing operations within regions based on governing board control.
- .. To contract collectively or individually with commercial organizations for the necessary services.
- .. To encourage the universities and colleges to cooperate among themselves.
- .. To continue the present course.
- .. To create a public-interest, not-for-profit education corporation to provide all computer services.

Using the criteria presented in the last chapter, the Task Force recommends the creation of a public-interest, not-for-profit corporation as the best form for successful implementation of a statewide plan for computer resources. It is felt that this organizational form will:

- .. preserve institutional autonomy,
- .. guarantee long term stability,
- .. provide user control over allocation of computing resources,
- .. promote cost/effective applications of computers.

The other alternatives considered were lacking in one or more of these characteristics.

For example, regionalization within a governing system represents a consolidation and economy for public senior institutions. Certainly, the legal standing to guarantee long term stability and the line authority to insure cost/effective applications is present. However, this approach is less satisfactory for private institutions and community colleges since there is no mechanism for user control. Also, analysis indicates that two applications -- interactive computing and student express service -- require a larger economic unit than such a region provides, and further, there would be considerable duplication of communications if each governing board attempted to provide these services.

The Board of Higher Education is an entity that, because of its hierarchial position, was considered as a possibility for providing the organizational framework for statewide plan implementation. The Board, however, lacks the necessary statutory provisions to provide the line authority required for successful implementation. The Task Force does not recommend that an exception to the general coordinating powers of the Board for the provision of such line authority be sought at this time.

A State agency would also provide the necessary global viewpoint for successful implementation. However, this approach was rejected because at least from the institutions' viewpoint, there would be a question of the preservation of institutional autonomy under such an arrangement. There was also a question of how the private institutions might relate to such an organizational form.

The other alternatives were rejected because of their lack of line authority to develop a statewide plan. The Task Force is convinced that such authority must exist on a statewide basis if a plan is to be developed.

A Public-Interest Corporation

Organization. It appears that a public-interest, not-for-profit corporation has the desired characteristics necessary for successful implementation. As a corporation, there exists the legal powers necessary to acquire assets and conduct business. Since institutions can be represented on the Board of Directors there is an appropriate mechanism for general policy control by the user community. But, the operating staff would be employed by the corporation rather than the institutions and would be expected to exercise the line authority necessary to provide statewide services. Since there will be a charge for services, there is an economic incentive for the corporation to provide the services desired by the educational community. Since the corporation would not be controlled by or responsible to a specific institution, it provides the independent status necessary for stability and long term operations.

Such a corporation form could be established either by a legislative act or by the public senior institutions themselves. Legislative action may have some advantages in funding since long term funding could be backed by the "full faith and credit" of the State. On the other hand, inclusion of the private institutions, should the corporation be formed by the legislature, is in question. The public senior institutions have the legal authority to act immediately.

As a result, the Task Force feels that the initial impetus and direction must come from the public senior institutions. This recommendation is not intended to exclude the private and community colleges. These colleges can contract with the corporation for its services as soon as it is operational. Further provisions can be made for these colleges and universities to be represented on the Board of Directors of the corporation even though they don't "own" part of it. It becomes a matter of selecting the appropriate body to have represented on the Board. The Task Force suggests the Executive Secretary of the Illinois Junior College Board and the Executive Director of the Illinois Association of Independent Colleges and Universities.

The Task Force is very sincere in its belief that the Board of Directors must consist of a reasonable number of top-level policy makers from the educational community. Technicians on the Board will cause the Board to attempt to control rather than provide policy guidance.

Beyond these restrictions, the Task Force is not overly concerned about the composition of the Board. Since the corporation must provide the desired services or suffer financial failure, it is felt that whatever the composition, the Board will be responsive to its users.

Implementation. After incorporation, the responsibility for planning and implementation will rest with the corporation and its Board of Directors. It is desirable to present here a specific implementation plan for the corporation's consideration in order to demonstrate feasibility and to provide the corporation with a planning base so that implementation can proceed immediately.

The Task Force expects that for such a corporation to be viable it would:

.. Be not-for-profit.

.. Operate such computing equipment as necessary to provide services -- on-line and off-line, interactive and batch -- to all public senior institutions and to such community and junior colleges, private institutions of higher education, school boards, and eligible government agencies as may desire to purchase such services.

.. Own or lease all computer and peripheral equipment used for computer services of any kind in all public senior institutions of higher education in Illinois, and when appropriate and desired by the institution, for private institutions and community and junior colleges. (The corporation would purchase all institutionally owned equipment and provide either service credits or reimbursements.)

.. Charge for these services on a revolving fund approach with annual prices which are intended to be lower than any available from any responsible commercial organization.

.. Hire and direct a staff to:

(a) Manage the corporation as directed by the Board of Directors of the public-interest corporation.

(b) Operate the equipment.

(c) Provide system software support and maintenance.

(d) Develop all central software and data bank systems.

(e) Insure that the data of each institution while in the corporation is secure.

(f) Coordinate any new statewide systems for management, research, education, or funding.

(g) Coordinate, as appropriate, modification and development by specific institutions.

(h) Act as a technical advisory agency when requested by the Board of Higher Education for all contractual services of any kind associated with information systems.

In order to achieve this initial implementation, the public senior institutions would enter into contractual arrangements with the corporation. These contracts should:

- .. Leave ownership of the data and direction concerning its use with the institutions or agencies creating the data.
- .. Leave responsibility for accuracy and completeness of the data with the institutions or agencies creating the data.
- .. Establish fixed rates for each level of service and priority for the first year of operation.
- .. Relegate responsibility for central systems development to the corporation and for modification and implementation to the institution.
- .. Transfer hardware, software, and system assets to the corporation and assign all current contracts to the corporation in exchange for service credits or reimbursements.
- .. Maintain institutional responsibility for the EDP budget line-item for computer equipment and related services.

These suggested actions provide for the corporation and its purpose, and the initial steps of implementation. Because of the participation of the institutions and State agencies in this study, it is expected that should the concept of a public-interest corporation be adopted, the resulting implementation will likely be similar to that proposed.

Such organizational changes can not be accomplished overnight, nor can they be accomplished without changes to the initial plans. Thus, the following schedule is suggested:

- .. A one year cycle, ending June 30, 1973, during which the mission, structure, and organizational approach for the public-interest corporation will be established. During that time, inter-institutional services should be provided on a contract basis.

.. A two year period ending June 30, 1974 during which moves would be completed to establish the corporation's direct control and responsibility for staffing and operations.

.. A review and commitment by June 30, 1974, for the corporation to be operative until at least 1980, with a contractual guarantee of the procedures and services to be delivered by the corporation to the institutions during that period.

Funding. It is recommended that the public-interest corporation be entirely self-sufficient in funding. As a corporation, it can borrow money to finance equipment purchases. Using the revolving fund approach, it can charge for services, adding an overhead charge to time-rental charges to cover personnel and other costs. By having the corporation establish and publish rates for service, the private institutions and public junior colleges will be provided with information that will enable them to make a decision on whether or not to subscribe to a service.

Funding for computer activities at the public universities should be continued as it currently exists. For public universities, this implies that funding should be secured under the procedures established during the review for FY73 budgets.

By establishing such a procedure, an annual review of the way a public university is expending its funds for computing activities is established. It is expected that the public-interest corporation and the institutions will establish contracts for certain services. Because of the normal start-up difficulties experienced by a new entity, it is recommended that the public universities be a "captive" customer of the corporation when securing interactive processing capabilities (see section on Service Priorities) for the first two years of operation. However, once this transition period is passed, it is recommended that no restrictions be placed on the public universities and if in the annual review, less expensive ways of securing equivalent service can be demonstrated, budget levels should be recommended at these lesser amounts. Such a "check and balance" will provide an incentive to the corporation to be competitive with services secured locally at the university and from outside sources.

Service Priorities

Earlier in this report the types of computing service which appear to be common to all educational institutions were discussed. Briefly, these are:

.. interactive instructional computing,
.. instructional batch processing,
.. problem solving for instruction and research,
.. administrative data processing.

A detailed development of a plan to provide these services should be the top priority for the new public-interest corporation. The Task Force feels that such a plan should satisfy the criteria established in Chapter V. Thus, the following paragraphs present a rationale which the Task Force feels will provide for ease of transition and minimize risk of failure.

Risk. Of the kinds of service described above, the one most consistently supplied regionally, both commercially and by educational institutions, is interactive terminal service. Because of the economics, large scale computers offer significant cost and performance advantages over smaller computers. The technology is well developed and providing remote service is typical. There appears to be no significant technical problems in implementation.

Regional networks, or distributed networks, are now providing student batch processing to a number of institutions. This method is being increasingly used at large institutions to provide service at several locations on the campus, or to remote campuses. Such remote job entry terminals have been used in several institutions during the past few years, and the necessary communications and software support have been developed. This approach is particularly useful for institutions whose computing load does not justify the expenditures for a computer large enough to support the national standard languages and the typically used educational software.

The economics of the large scale communications necessary to support the general computing requirements for institutions with large general computing demands have not been established. However, this form of networking is becoming increasingly used by institutions and commercial firms where computer use does not justify a large computer installation. This type of service, because of the variety of software support and hardware capabilities, is more difficult to install and manage than a student batch processing capability.

Administrative applications appear to be technically the most difficult type of data processing service to provide. This does not result from the lack of technology to support administrative terminals, remote job entry, or even combined instructional, research and administrative services. Rather it results from the difficulty in organizing the software development effort so that special equipment facilities are not required and so that common use of software is feasible. The use of American National Standard languages, good practices of systems design and programming, and data base management systems provide the basic capability, but as yet, they are infrequently found in practice. For these reasons, common administrative data processing appears to offer some technical and management difficulties, and the risk of failure is perhaps greater than for the other three types of service. Administrative systems also have some stringent performance and scheduling requirements on network operations which requires skilled and experienced staff and good operating policies and procedures. These operational capabilities are sufficiently difficult to achieve in practice that few institutions of higher education have successfully cooperatively developed or implemented administrative systems. On the other hand, the individual development of good administrative systems is expensive and cooperative development offers a significant potential source of savings, or perhaps, better capabilities for a fixed investment.

Because of the current state-of-the-art, it is possible to achieve an operational capability for interactive terminal service or student batch processing in a few months. A longer time is required to provide the general computing service. Administrative systems, primarily because of the software development, require a lead time of many months.

Thus, either interactive terminal service or student batch processing appears to be available in a few months without significant risk of failure.

Institutional Needs. All of the public senior universities and many other institutions have the capability of processing student batch jobs. But many do not offer interactive terminal service and have indicated, in their budget requests, the need for this service. Such service comes only in "large economy" size, but most institutions have installed only a few terminals on their campus. This results in terminal hour costs of ten to 100 times the cost per terminal hour of an economic size installation.

Furthermore, there is only a limited language capability at each institution (but not always the same language).

There is also a need to make the student batch job capability economically available to all institutions, public and private, in Illinois, in order to have a standard of high quality instruction. Knowledge of computers has become too much a part of the professions and vocations to have students graduate without having an opportunity to develop an appreciation for the computer's capability and the skills necessary to utilize that capability.

Suggested Strategy. In order to fill the institutional needs, it appears that the logical first step for interinstitution cooperation in computer services should be the implementation of interactive terminal service. A large installation could achieve both low unit costs and a variety of services for the institutions it serves. Thus, it is possible to achieve, within a few months, a capability at a significant cost savings which, because of budget stringencies, has been denied to the institutions.

In order to provide an adequate level of service to institutions which do not have campus computing facilities, and to those with uneconomic campus facilities, it is desirable to install a student batch capability. Because this capability may require a very large installation to achieve lowest units costs, it appears that this service should be the second to be considered for implementation through interinstitutional cooperative efforts.

A general computing capability may be initially performed on the same equipment which provides student batch processing. It can be phased into a major installation as soon as the scheduling problems can be solved. Thus, the general computing capability can be achieved by adding new services and support as they can be developed.

Because of the organizational and technical difficulties of administrative data processing, it is suggested that this service be the last to be provided by a cooperative computing facility. But at the same time, it also requires the longest lead time of the four types of computing, and can provide significant savings, particularly when budgets are restricted and administrative activities must be continued and improved. Although the data processing capability may come last, the interinstitutional development of the administrative systems capability should be started as soon as the cooperative organization is functioning. Because of this, an entire section later in this chapter will discuss alternative ways of approaching cooperative development of administrative systems. It should be recognized that progress may be a lengthy process. But the capability should be developed to permit this testing and pilot implementation. Such a capability could be added, without significant cost, to either student batch capability or with the implementation of the general computing capability.

Procedure and Timing. A good deal of speculation currently exists at public and private institutions regarding the consequences of the inauguration of a statewide plan for computer resources. Confidence in the corporation's ability to provide service will have to be built. In the Task Force's opinion nothing could go further toward building this confidence than a competent, production-oriented management with the line authority necessary to build systems required for the service. The Task Force, then, recommends to such a management that the following be addressed immediately so that institutional representatives can make institutional and career plans:

.. A definition of workloads that are to be processed on campus, and the workloads to be processed via a network.

- A definition of the applications to be developed centrally and those to be developed locally.
- A specification of the hardware configuration, and staff size and type that is to be resident on each campus, based upon the above considerations.
- A specific timetable of services to be offered and applications to be developed.

While at least interactive and remote batch services have been successfully demonstrated elsewhere, it is expecting too much to assume that specifications and definitions for these services can be developed overnight. However, the following time-frames and arrangements are not unreasonable goals for implementation of the suggested services:

- Implementation of a network service to provide instructional time-sharing by January 1, 1973.
- Implementation of a network service to provide remote batch processing for instructional purposes by June 30, 1973.
- Implementation of a network service to support the general class of computing where the computer is used as an instructional problem solving tool, by June 30, 1974.
- The immediate embarkation of an interinstitutional development project for administrative systems, pointing to the implementation of initial systems not later than June 30, 1974.
- The establishment of the University of Illinois at Urbana as the site for the operation center for the network activities during FY73.
- The establishment of other operation centers as the workload and cost effectiveness demonstrate their need.

Many procedures will be required to implement the services suggested. The remainder of this report consists of discussions regarding specific procedures and alternatives which the Task Force consider essential to successful implementation of a statewide plan.

Consolidation Approaches

The audit conducted by Morrison and Rooney Associates, Ltd., indicates that excess computer capacity exists in the public university system. Such excesses, without considering any consolidation is costing the State at least $338,000 annually (the University of Illinois at Urbana was not audited). If consolidation and selective purchasing is considered, an additional net savings in computer hardware exceeding $1,199,000 can be realized. If other reductions in personnel and other line items are considered, a total savings of 3.5 million dollars can be realized.

From the hardware standpoint, it is felt that the public institutions can achieve the same effectiveness as currently exists at the lesser cost. It is expected, however, that the institutions can achieve a greater effective use of the computer through cooperative development.

Interactive Computing. One such approach which the Task Force feels is economically viable involves the development of a statewide network for interactive instructional computing. Figure 11 indicates that the most economical point for the operation of such a system occurs at 384 terminals.[1] Such a point is well beyond the capability of any single institution's support. Based on an estimated annual cost of $650,000 to $750,000 for leasing the hardware necessary to drive such a network, the annual cost of operation would be approximately $3.7 to $3.8 million. Such a network would be capable of handling the current demand for interactive service (an estimated 80 to 90 terminals with student usage in the public universities).

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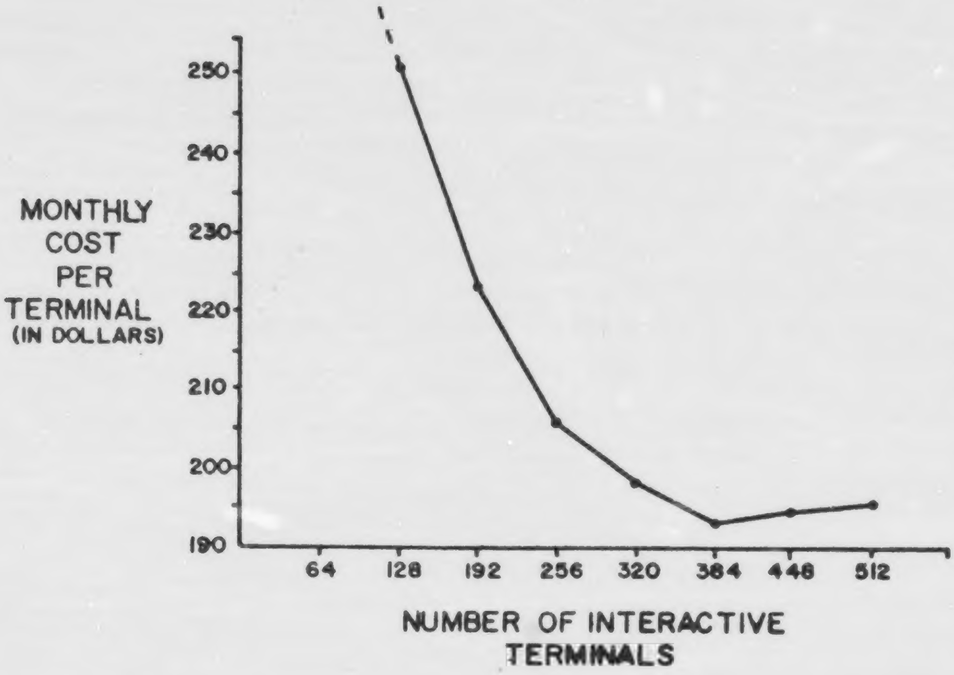
[1] As indicated in "A proposal to the Illinois Universities' Consortium for Computer Services and the Illinois State Board of Higher Education for a Statewide Education Computer Network," by the Control Data Corporation.

Figure 11

Computer Cost per Terminal
for an Interactive Instructional Network



As demand in public and private institutions grow, a second such network could be added. Due to reductions in telecommunications and software development costs, it is expected that the operation of a second network might cost approximately $3.0 million. It is expected that some remote student batch work might also be handled by such a network, however, the Task Force feels that further analysis must be accomplished to determine the percentage of the batch load that can be accommodated.

Mini-computer Approach. The Morrison and Rooney report describes a consolidation approach which involves the location of mini-computers on each public university campus tied into a front-end communications processor and computer at a central site via 50K b.p.s. lines (see Appendix M). They estimate that this single network could provide for all functions (interactive, student batch, and administrative batch). Based on some gross calculations, it is estimated that such a network would cost approximately $5.1 million annually for hardware and telecommunications alone. This, however, is approximately $400,000 less than what the public universities requested for computer equipment for FY73.

Management. Such proposals for statewide implementation immediately cause speculation on how an institution would tie into such a network and on what types of terminals and languages such a network will support. This suggests that if such services are to be offered by the public-interest corporation, one of the first tasks for the staff will be to specify terminal interface, language, and telecommunications standards.

The Task Force again must stress that, in our opinion, the success of an orderly plan for consolidation does not depend upon the ultimate hardware configuration. Rather, it depends upon good management addressing the problems of consolidation (such as the standards problem suggested above).

One possibility for the provision of the necessary management talent involves a joint effort between the private, commercial sector and the universities. Under such an arrangement, a commercial concern and the universities would be joint owners of a not-for-profit corporation. The commercial concern could contract to provide the services required as directed by the Board of Directors of the Corporation. Joint ownership would insure that the services provided would be offered on an efficient and competitive basis. Because such a joint effort might provide an influx of necessary management talent, the Task Force feels that this concept is worth further investigation.

Long-Term Funding

One of the advantages that the corporate form offers, is the ability of the corporation to secure long-term funding, e.g., through a bond sale. Such funding could be used to reduce computer equipment costs. Unlike other components of the cost of data processing (such as personnel, space, and supplies) these computer equipment costs are variable depending on decisions affecting:

- .. lease or purchase,
- .. obsolescence risk, and
- .. installation life of the hardware-software system.

In addition, other factors which must be taken into account are:

- .. true equipment life,
- .. residual resale value as a function of time, and
- .. the cost of money.

Cost Savings. To illustrate the various factors involved, an example will be developed for a system that sells for $3,000,000. In the event of purchase, maintenance and insurance charges are extra. The general maintenance policy is as follows:

1. 90 days warranty on peripherals.
2. 12 month warranty on the mainframe.
3. Maintenance fees, when applicable, at 1/10th the base rental.

Leasing, on the other hand, is normally at a base monthly rental of 2% of the purchase price, where such rental includes maintenance and insurance. However, even in leasing situations, the user has some insurance coverage, but at a lower cost.

For the $3,000,000 system, let us assume that:

1. The mainframe and peripherals are equal in value.
2. On purchase, insurance varies between 0.5% and 1% per year, and is negligible in the event of leasing.

Hence, the following applies:

1. Rental cost is
   - .. Lease @ 2% of $3,000,000 = $60,000 per month
   - .. Insurance = --
   - .. Maintenance is included = --
   - .. TOTAL monthly cost = $60,000 per month
2. In the event of purchase,
   - .. Maintenance first 3 mos. = $ 0
   - .. Maintenance next 9 mos. = 0.2% per month on peripherals valued at $1,500,000 = $ 3,000 per month
   - .. Maintenance after first year = 0.2% of whole system of $3,000,000 = $ 6,000 per month
   - .. Insurance @ 0.5% per year = $ 1,250 per month

To find the total cost per month, it is necessary to set the residual value, the interest rate, and the amortization period.

Third generation computers are experiencing useful operating lives already in excess of seven years, with values after five to seven years equal to approximately half the initial list purchase price. On such an historic basis, and also consistent with current lease-back financing practices since 1965, it is justifiable to set a ten year life with a ten percent residual. The value as a function of time is shown in Table 20. Using a level payment approach, at 6% per year interest, this would amortize $3,000,000 over 120 months at $33,309 per month or $399,708 per year. If other interest rates are to be used, the equivalent value may be found in Table 21.

TABLE 20

Declining Value Of $3 Million Worth Of Computer Equipment Over Time

YEARS INSTALLED	% VALUE	VALUE OF AN INITIAL $3 MILLION
1	90%	$2,700,000
2	80%	2,400,000
3	70%	2,100,000
4	60%	1,800,000
5	50%	1,500,000
6	42%	1,260,000
7	34%	1,020,000
8	26%	780,000
9	18%	540,000
10	10%	300,000

TABLE 21

Monthly Cost of Amortizing At Various Interest Rates For A Ten Year Period

INTEREST RATE	MONTHLY AMOUNT PER THOUSAND	ANNUAL AMOUNT ON INITIAL $3 MILLION
4.0	$10.125	$ 364,500
4.5	10.364	373,104
5.0	10.607	381,852
5.5	10.853	390,708
6.0	11.103	399,708
6.5	11.355	408,780
7.0	11.611	417,996
7.5	11.871	427,356
8.0	12.133	436,788

Table 22 shows the comparative lease cost versus purchase cost of $3.0 million of computer equipment based on the above assumptions. Table 23 shows the cost of the equipment should it be sold during any of the ten years of its life. In all but the last two years of the ten year amortization period, additional capital beyond that expected from sale of the equipment would need to be generated to retire the long term obligation used to purchase the equipment initially. However, Table 24 indicates that even with this requirement, there are substantial savings with purchase as opposed to leasing, with these savings increasing over time to a total of $2.7 million.

It should be pointed out that obsolescence risk factors come into play beyond five years. This is especially true with peripherals. Advances in modular core memory, larger on-line memories, and low cost core, however, are prolonging the useful life of the larger central processing units (CPU). As a result, it would appear prudent to:

1. Purchase central processing units.
2. Lease peripherals.
3. Aim for a useful life of a computer system at five years or more.

Such actions will, depending upon the source of the peripherals, save about 20 to 30% of the cost of computing hardware and will minimize the risk of obsolescence.

Other Examples. It is interesting to note that the example of $3.0 million just presented is the approximate cost of the computer equipment necessary to support a statewide interactive instructional network (see Section on Consolidation Approaches).

TABLE 22

Annual And Cumulative Lease And Purchase Costs Over 10 Years, Interest At 6%

(a) Lease

YEARS INSTALLED	LEASE	CUMULATIVE TOTAL LEASE COST
1	$720,000	$ 720,000
2	720,000	1,440,000
3	720,000	2,160,000
4	720,000	2,880,000
5	720,000	3,600,000
6	720,000	4,320,000
7	720,000	5,040,000
8	720,000	5,760,000
9	720,000	6,480,000
10	720,000	7,200,000

(b) Purchase

YEARS INSTALLED	AMORTIZATION	MAINTENANCE	INSURANCE	TOTAL PURCHASE COST	CUMULATIVE TOTAL PURCHASE COST
1	$ 399,708	$ 27,000	$ 15,000	$ 441,708	$ 441,708
2	399,708	72,000	13,500	485,208	926,916
3	399,708	72,000	12,000	483,708	1,410,624
4	399,708	72,000	10,500	482,208	1,892,832
5	399,708	72,000	9,000	480,708	2,373,540
6	399,708	72,000	7,500	479,208	2,852,748
7	399,708	72,000	6,300	478,008	3,330,756
8	399,708	72,000	5,100	476,808	3,807,564
9	399,708	72,000	3,900	475,608	4,283,172
10	399,708	72,000	2,700	474,408	4,757,580

TABLE 23

THE COST OF PURCHASE CONSIDERING AMORTIZED VALUE AND SALES VALUE

(Initial cost $3,000,000)

(Ten year amortization at 6%
with $300,000 residual)

(Intermediate values as per
Table 20)

YEARS INSTALLED	AMORTIZATION		SALES VALUE			CAPITAL[2] LOSS IN ADDITION TO AMORTIZATION
	PAID	NOT PAID	GROSS	COMMISSION[1]	NET	
1	$ 225,000	$2,775,000	$2,700,000	$100,000	$2,600,000	$175,000
2	465,000	2,535,000	2,400,000	100,000	2,300,000	235,000
3	720,000	2,280,000	2,100,000	100,000	2,000,000	280,000
4	990,000	2,010,000	1,800,000	90,000	1,710,000	300,000
5	1,378,000	1,622,000	1,500,000	75,000	1,425,000	197,000
6	1,581,000	1,419,000	1,260,000	63,000	1,197,000	204,000
7	1,905,000	1,095,000	1,020,000	51,000	969,000	126,000
8	2,250,000	750,000	780,000	39,000	741,000	9,000
9	2,513,000	387,000	540,000	27,000	513,000	-126,000
10	3,000,000	--	300,000	25,000	275,000	-275,000

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(1) Sales commission at 5% of sales, with minimum of $25,000 and maximum of $100,000.

(2) Capital loss is an amount to be paid to bring amortization to balance with net sales value; if negative, a residual value.

TABLE 24

COMPARISON OF PURCHASE AND LEASE COSTS

YEARS	CUMULATIVE (1) LEASE COST	CUMULATIVE (2) PURCHASE CASH OUTLAY	CAPITAL (3) LOSS OR RESIDUAL VALUES IF SOLD	NET PURCHASE COST	PURCHASE SAVING	SAVINGS AS A % OF TOTAL LEASE COST
1	$ 720,000	$ 441,708	$ 175,000	$ 616,708	$ 103,292	14.3%
2	1,440,000	926,916	235,000	1,161,916	278,084	19.3
3	2,160,000	1,410,624	280,000	1,690,624	469,376	21.7
4	2,880,000	1,892,832	300,000	2,192,832	687,168	23.9
5	3,600,000	2,373,540	197,000	2,570,540	1,029,460	28.6
6	4,320,000	2,852,748	204,000	3,056,748	1,263,252	29.3
7	5,040,000	3,330,756	126,000	3,456,756	1,583,244	31.4
8	5,760,000	3,807,564	9,000	3,816,564	1,943,436	34.1
9	6,480,000	4,283,172	-126,000	4,157,172	2,322,828	35.8
10	7,200,000	4,757,580	-275,000	4,482,580	2,717,420	37.7

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(1) Table 22(a)

(2) Table 22(b)

(3) Table 23

Another example of the advantages of long term funding of computer equipment is presented in a computer manufacturer's proposal to the Task Force. Figure 12 shows that by immediately establishing a network with four large central processors at two centers, and purchasing an additional IBM 370/165 or equivalent every two years beginning in 1975, the cost of computer equipment remains below that currently being spent (September, 1971). Yet, as shown in Table 25, the capacity of the network in 1977 would be three times the total current capacity in the public universities. These estimates are based on the manufacturer's purchase plan (a five year payout at 4.5% interest) and would cost even less if paid out on a ten year basis as suggested above.

A final example of the leverage obtained by long term funding is shown in Table 26. This example assumes that the true life of the computer equipment existing at the public universities is ten years. In the example it is proposed that all the computer equipment be purchased with a payout for that purchase equal to the remainder of each piece of equipment's true life. An interest rate of 4.5% is assumed. Such a plan would reduce the monthly payout by 46%, or a yearly reduction of $2.41 million (without insurance and resale considerations).

Figure 12

Annual Computer Hardware Expenditures
Cash Flow
Illinois Public Universities

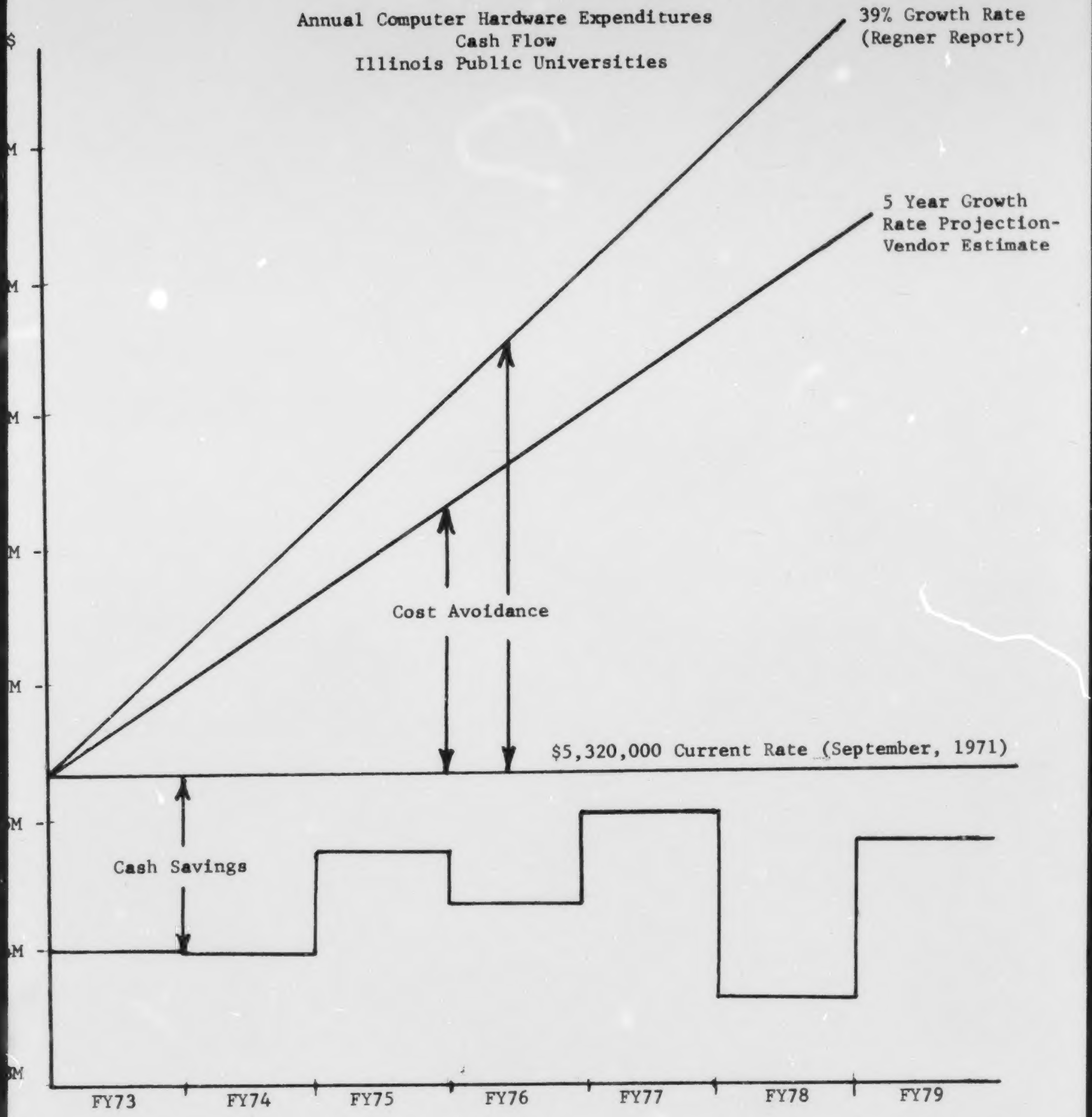

TABLE 25

ESTIMATED GROSS COMPUTING CAPACITY*

	ANNUAL COST	COMPUTER EQUIVALENTS**	COST PER COMPUTER EQUIVALENT
Current	$5.3 million	18.8	$281,000
Network	4.0	28.3	141,000
1977 Growth	8.6	46.6	185,000
1977 Network	4.9	58.3	84,000

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* Based on a preliminary plan submitted by IBM. The growth plan suggests larger central processors on every campus and, compared to recent growth, is quite conservative.

** Capacity expressed in IBM System 360 Model 50I with extended core storage based on benchmark data for typical batch processing.

TABLE 26

CURRENT MONTHLY PAYMENT PLAN VS. MONTHLY PAYMENT BASED UPON AMORTIZATION OVER FULL LIFE EXPECTANCY
(TEN YEAR BASE)

INSTITUTION	SYSTEM	DATE CPU INSTALLED	LIFE	PRESENT EXPENSE AS OF 9/15/71	NET PURCHASE AS OF 1/1/72	MINIMUM MONTHLY MAINTENANCE CONTRACT	MONTHLY TEN YEARS	WITH MINIMUM MONTHLY MAINTENANCE CONTRACT
Illinois State University	360/50 1130	7/70 3/70	9 8	$ 27,351 2,560	$ 1,115,000 115,600	$ 1,758 438	$ 12,600 1,433	$ 14,358 1,871
Western Illinois University	360/50	1/68	6	15,411	388,800	1,391	6,182	7,573
Northern Illinois University	360/67 360/20	12/70 9/70	9	58,123 3,087	1,750,000 90,000	4,796 470	19,775 1,017	24,571 1,487
Eastern Illinois University	360/50	10/68	7	25,467	706,650	2,258	Pur. 10/71	12,080
Southern Illinois University Edwardsville Campus	360/40	5/70	8	17,415	568,600	1,347	7,050	8,397
Southern Illinois University Carbondale Campus	360/65	4/71	9	49,740	1,666,494	4,367	18,831	23,198
Chicago State University	360/50	12/70	9	21,990	811,800	1,699	9,173	10,872
Northeastern Ill. Univ.	360/30	10/69	8	9,446	353,000	830	4,377	5,207
University of Illinois Chicago Circle	360/50	7/67	6	9,546	317,000	1,682	5,040	6,722
University of Illinois Medical Center	360/40	6/69	7	13,987	483,000	1,221	6,714	7,935
University of Illinois Chicago Circle - Comp. Ctr.	370/155	9/71	10	42,000	2,000,000	4,000	20,800	24,800
University of Illinois Medical Center - Comp. Ctr.	370/155	8/71	10	35,000	1,800,000 (est.)	3,500	18,720	22,220
University of Illinois Urbana - ADP	360/50	6/67	6	23,060	650,662	4,074	12,102	16,176
University of Illinois Urbana - CSO	360/75	12/67	6	81,560	2,700,000	7,235	40,230	47,465
Totals				$435,743	$16,515,606	$10,966	$184,044	$234,930

Pricing for Computer Services

Except for the University of Illinois system, the universities in all other public systems treat computer systems as a "free good" and consequently it is natural for users to attempt to monopolize as much of the machine as possible since there is no scheme for setting priorities or allocating machine use. Further there is no incentive to use alternate, less expensive methods of computing. In many cases the computer is used because "it is there." There may be little thought given to whether the particular application is a cost/effective use of the computer resource.

Since computer resources will be "scarce", at least during some periods of time, it will be necessary for the public-interest corporation to develop a pricing machanism. Further, it would appear reasonable for the colleges and universities to also develop a pricing mechanism to perform the allocation function among users. Most large university computer centers, in response to Federal regulations governing grant expenditures, have developed pricing schemes. Traditionally the total costs of a computer center, including programming staff, have been divided by the number of hours the computer center was operated to arrive at a single average rate. Because of the complexities of large multi-programming computers, these rates have been divided into resource use -- disk drives, core, etc., and time -- CPU time, input-output channel time, etc. But essentially the rates were the same whether the user processed at the peak hour, typically in the afternoon, or in the early morning of a holiday. Computer center directors frequently cited Federal auditing practices as the justification for this procedure.

This approach of"average pricing" leads to the phenomena (at computer centers with Federal research) of an under-utilized computer at the same time there is unfulfilled student and faculty demand for computing. Similarly on campuses without a pricing formula, computer center directors requested additional equipment to cope with the peak load period with no mechanism, except reduced service, to encourage users to use off-peak periods.

But neither case is required. The Federal regulations merely require a pricing formula which is non-discriminatory to users; there is no requirement for prices to be the same for all periods of the week. Quite to the contrary, the Federal government encourages differential pricing since typically it increases the machine utilization and decreases price. Some large computer centers have installed differential pricing either for off-prime shift hours or for deferred processing. Unfortunately the differential has been low, 2 to 10%, and little additional use of off peakloads has developed. This merely says that for a 2% differential most students and faculty would prefer to work during the day at the higher prices. Commercial firms, and the Management Information Division Computer Center, Department of Finance, where there are additional incentives for cost savings, find that differentials of 20 to 100% are required to develop off-shift loads.

If pricing is then used as the allocation mechanism steep price differentials can be used to distribute workload, and hence achieve higher utilization. For example, in computations for interactive terminal service, the goal was $1.00 per hour during weekdays from 9:00 A.M. to 6:00 P.M., and 25¢ per hour at other hours. It appeared this differential would cause increased use at night and weekends, particularly for heavy users, resulting in better service (large users would not be competing for resources during the day), and reduced costs to the user (full utilization reduces the day rates as well).

Because of the demand pattern, this rate appears to be equivalent to the single rate of about $2.00 per hour.

Pricing schemes can be utilized even though there are no "real dollars." By allocating amounts for computer use to departments or end-users, the same behavioral effects can be achieved even though these "dollars" cannot be used for anything other than computing service.

Pricing schemes also give, through comparison, a measure of efficiency for computing centers. Many computing centers make large investments in modifications of manufacturer's provided software or in development of other software. The costs of their development is passed on to users as part of the "overhead." It appears that this overhead may consume as much as 30 to 50% of the machine resources at some Illinois university computing centers. Pricing invites comparisons and hence requires careful management attention to all overhead costs to preclude high prices.

On a similar basis, many computer centers maintain consulting services. It is intended that these staff specialists would provide short-term assistance to users, typically only a few minutes of expert advice. Without a pricing mechanism, these services are a "free good" and users require considerable support in debugging programs, developing job control language, or training in even a new programming language. Yet where these services are provided at cost, users find other ways to get technical assistance -- primarily by reference to manuals on other users. If pricing is used as an alternative mechanism, it encourages additional user training and careful attention by the user to the costs of programming.

Pricing mechanisms, then, become a method of allocating computer resources among users, providing the computer center staff with an incentive toward providing a low cost, high quality service, and providing institutions with a public and equitable measure of efficiency.

ADP Systems Development

Costs. As evidenced elsewhere in this report, the cost of software is a significant cost component of data processing. This results from (a) programmer-intensive system development, (b) high maintenance systems, and (c) institutionally unique systems development. Each public senior institution of higher education in Illinois has from three to forty-two major systems currently under development accounting for 18 to 34% of administrative data processing use. Thus, software development not only requires a large staff, but uses a large part of available computer capability.

The budget recommendations for FY73 will slow this development work substantially, due to the recommended reductions in personnel support. The Task Force feels that in many cases a consolidated and coordinated approach sponsored by the public-interest corporation is the best way for administrative development to be achieved in the future.

Several approaches to minimizing the investment in software should be considered. These include: (a) maximum use of vendor supplied software, particularly operating system, utilities, and language processors, (b) use of packaged software, either from public-domain development efforts in higher education or from proprietary software firms, (c) adaptation of similar software packages at other institutions, and (d) cooperative software development. While centralization of computer hardware offers some potential cost savings, centralization of software development appears to offer even greater savings. The ultimate question, then, is the comparative effectiveness of alternate development strategies.

General Data Management Systems. General data management systems (DMS) appear to offer significant economies over the current technique of writing unique programs. First, a large number of the needed reports can be obtained directly by a user using the inquiry and reporting capability of the data management system. Second, there is a significant reduction in program maintenance since the data base can be changed without requiring changes to any programs except those that explicitly use the changed or added elements. By contrast, the change in any record size in conventional systems usually requires that all programs using that file be modified. In integrated systems this may mean that one to two hundred programs must be changed each time a data element is added or format changed. Each of the modified programs then has to be fully tested. Third, it permits the programmer or user to "program" using his own data element relationships, and a part of the data base as if it were his own. This provides independence from one user to another by always qualifying identical names (to the system) and equating different names (from different users) to the same data element.

The development and use of a generalized data management system (DMS) was one of the primary recommendations of IMPACT '70. The report also suggested that the DMS should be vendor independent, much as COBOL now is hardware vendor independent, and that Illinois should promote a national standard for a DMS that all hardware vendors must support. The author pointed out, "The question is not whether to use a DMS, but rather of when, what, and how." There are several systems which purport to be a DMS. For example, QWUIK-QUERY, System 2000, and MARK IV have the language characteristics for retrieval and reporting, IBM's GIS has the capability of information retrieval from a data base, Cincom's TOTAL, MRI's System 2000, and IBM's IMS-II provide a data base and appropriate interface with COBOL, PL/I, and FORTRAN. There are not yet any which satisfy all of the requirements of IMPACT '70.

The primary argument against DMS, or the present DMS-related program products, has been economic. Typically DMS presupposes large on-line storage (but the cost of storage continues to drop significantly each year), a sophisticated operating system (most users now use DOS, OS or its equivalent), or additional computer time. Although the cost of the computer time is continuing to decrease, a significant percent (some 30 to 50%) of the computer capacity is being used in program and system maintenance. Thus even if DMS required a 10 to 20% increase in machine time during use and resulted in no savings of programmer time, the system could be cost effective. There is considerable evidence that programs using DMS can be developed and tested in significantly less time than the typical programmer takes to develop conventional programs, since all of the data base manipulation is performed by the DMS, not the application program.

The Illinois institutions of higher education are particularly fortunate since the State has taken the lead in developing and testing DMS. Currently they are using IBM's IMS-II. In several applications this has resulted in significantly reduced programming costs. In other applications it has led to a single data base for several users with the decreased costs, increased currentness, and reduced errors. These improvements in quality and cost savings were obtained with increased hardware use.

Thus, the institutions of higher education should follow these developments and implementation closely and should take advantage of this experience, but the institutions should not duplicate a DMS development effort.

They should follow State standards as soon as they are developed, should implement DMS as it proves cost-effective in State government, and should develop the appropriate common data element dictionaries (including classifications, codes and formats) as soon as possible so that current applications will be compatible with future DMS implementations.

Cooperative Applications Development. Institutions should not wait for a completed and tested DMS before improving their application systems. Rather they should adopt a strategy which would permit application development and implementation while retaining the option of using DMS when available. There are, however, several steps which should be taken to minimize overall cost. These include:

.. Develop a statewide data elements dictionary for higher education based on the NCHEMS/WICHE developments. (Data Elements Dictionary, 2nd Edition is due March, 1972.) The data elements dictionary should include codes, field formats, and data element name for FORTRAN, COBOL and PL/I.

.. Develop statewide programming standards including language subsets, core sizes, peripheral use, program structure, and internal and external documentation. The purpose of these standards is to permit programs developed at one institution to be used at others. Programs should be modular insofar as practicable to facilitate adaptation.

.. Develop statewide application descriptions which identify the common and institutional unique characteristics of a particular application such as admissions, student records, accounting, etc.

.. Coordinate development so that institutions and governing boards will know which institutions are doing which applications. When a central organization is implemented, then this organication should (a) coordinate institutional effort, (b) direct central development of applications for using generalized systems

> design, and (c) maintain a central directory and library of relevant software. This directory and library should be available to the community colleges and private institutions.

These first steps can significantly improve the interchangeability of software, i.e., the ability of one institution to use the software implemented at another institution. Such standards encourage the complete development of software including adequate documentation and testing which will reduce software maintenance.

To date attempts at establishing such standards have been ineffective due to the lack of ultimate line authority to set policy and manage development activities. All four public higher education governing systems have some type of control over systems development in theory, but thus far, have not exercised this control to any great extent. Since the governing systems are autonomous and since there are no comparable bodies in the junior college and private institution area, no statewide standards have developed.

Some have suggested that the development of such standards properly falls within the province of the Board of Higher Education. Because of the lack of authority to make final resolutions in such matters, it is felt that the Board of Higher Education is not the most appropriate body to manage this activity. Such an attempt would add a considerable amount of time to the development as the Board of Higher Education staff attempted to achieve consensus among the institutions. It is felt that a more realistic approach would be to give this power to the public-interest corporation. Since the corporation is intended to be user controlled, it will benefit the institutions to reduce costs by expeditiously adopting standards.

Cooperative Developmental Efforts with Vendors. Cooperative efforts with vendors have taken place in the past in higher education. For example, the General Electric (now Honeywell) time-sharing system was cooperatively developed by General Electric and Dartmouth College. The benefits to Dartmouth (almost 90% of students exposed to computers) have been mentioned earlier in this report.

It would certainly be worth the effort to determine if such a cooperative arrangement could be negotiated for the development of generalized ADP software that can be applied in the college and university environment. It is conceded that in the past most such program products were too specialized or limited. However, IBM recently announced its EPIC series of program products designed primarily for primary and secondary education, but in some cases, to provide for higher education's needs. Current announcements include:

.. EPIC: Fast - a test scoring system,

.. EPIC: Socrates - a student scheduling system,

.. EPIC: Student - a student records system,

.. EPIC: Budget/Finance - an accounting and budget control system.

This development certainly represents evidence that educational administrators can work with vendors to achieve packaged applications that provide for their data needs.

A cooperative venture with a vendor could help to achieve the development of statewide systems such as admission or student records. It is conceivable that the universities could provide a number of analysts to develop and implement such a statewide system. The vendor would match with an equal number of positions and a contract would be written specifying the work to be done. Ownership of the package could rest with both parties with free use of it in Illinois colleges and universities, and the vendor able to market it under license agreements to institutions in other states. In that way a large stumbling block for these types of efforts, namely, finances, would be removed. As an example, representatives of IBM indicate that similar ventures are already underway in other states and that they would agree to pursue this with the appropriate party, in our case, the public-interest corporation at some future time.

Toward A New Approach to ADP Activities

It is evident that Illinois higher education needs a new approach to the development activity in ADP; one that meets the criteria discussed in the previous chapter. Such systems to be cost-effective and responsive to long run needs must be designed with characteristics that are normally not found in todays implemented systems. Several of these considerations are discussed below.

Software Design. In addition to data management systems, there are several ways of designing software to permit easier use by other institutions. In addition to design standards which facilitate machine-to-machine transfer of software, these include:

.. Unused Record Space - The software can pass through the system 10 to 20% of blank record space. This permits later addition of data elements, or the processing of institutional unique data elements, without modification of the basic programs. In applications which appear to be rapidly changing, like student records, even additional space can be left.

.. Modular Programs - The programs can be designed to process data elements in program modules. For example, an edit program can group the program processing so each data element is handled in a contiguous, labelled and commented set of code. Then additional program code can be added for new data elements. Space should be provided in error, message tables, control total tables, etc. to facilitate program modification. Heading information should be formated for easy modification. Internal program documentation can indicate module boundaries and used space.

.. Modular Systems - Although there is some loss of efficiency, modular systems with interface programs are inherently more flexible than integrated systems. Detail should be retained in the system so long as practicable and aggregation should occur in such a way to permit immediate interchange with other systems. For example, the accounting system should have a transaction level sybsystem, a cost center level subsystem, and separate report programs. Thus data is available at two levels for interface with other programs, like unit costing and budget expenditure reports. Again changes to one system do not impact the whole of another system.

.. Report Writers - Rather than write a unique program for each report, a program should be developed which prepare a series of reports, usually with different levels of data aggregation, with selection capability, and limited changes in report format. This permits the system to provide different kinds of reports to different users.

.. Data Base Systems - Some systems can be programmed with the basic characteristics of a data base system -- the use of tables to define the data base, variable length record processing, and hierarchical indices -- which permit different uses. Current direct access techniques can support some of the simpler approaches.

Generalized System Design. Perhaps one of the most significant causes of software system obsolescence is the lack of application understanding by the system designer. Application systems should be designed for changes which will occur in the future. For example, current student records systems should consider credit by examination, interchange with other colleges, and modular scheduling. Thus the current design should include these changes which will occur in _future_ system requirements. The useful life of the software is extended several years. For example, good payroll systems include provisions for city and state taxes and withholding, even though these are not currently required in many areas. The additional cost during system development and test is small compared to later system modifications, particularly if the system design fully utilized every character of the record, every available byte of core storage, and every available code.

The ability of a systems analyst to foresee future developments and make appropriate _investment_ decisions about the future value of some software capability depends in large part on his understanding of the application area. The risk of producing an obsolete system can sometimes be ameliorated by reviewing several operational systems to identify features of potential future usefulness. Unfortunately the press for performance frequently causes an analyst to overlook future requirements, produce a system in minimum time -- which precludes low maintenance design and fails to completely test and document the system. These systems, typical in higher education where student programmers are used, become administrative time-bombs. They may fail at critical times, sometimes without the failure being immediately identified, or they may require a major future commitment to maintenance or early redesign through obsolescence. Generalized designs typically cost more for development, but result in lower maintenance and longer useful life.

Batch Versus On-Line Systems. There is a tendency, in higher education, to want on-line systems where users can directly interact with the computer via a typewriter or video terminal. There are three potential hazards in this approach: (a) the load imposed by these systems coincides with the instructional workload which may preclude high utilization of computers at other hours, and hence increase unit costs, (b) these applications typically are vendor dependent since a considerable part of the programs must be in machine language, and (c) the operational costs for a transaction oriented system are typically high. Another way of commenting on on-line applications would be to say they should be used when the value of immediately current information is high (like credit card validations), or when several users are interacting continuously with the data base (like an airline reservations system), or when data entry and data editing are combined. Although designers frequently overlook the possibility, many applications can be a combination of on-line and batch processing. For example, account balances could be processed on-line while account transactions and the resulting reports could be prepared through batch processing. Typically, it is account balances, not the list of transactions which has immediate value to decision-making and this design is an order of magnitude less expensive than keeping historical transactions in on-line storage.

The ultimate decision must be based on cost-effectiveness, and effectiveness typically is an improvement in decision making or service. Users should be aware, however, that costs for such interactive systems are high -- both in operational and development costs -- and may impose on a system diseconomies from the resulting high peakload of high priority applications.

A Suggested Strategy. With the uncertainty of availability of a cost-effective data management system, it appears the Board of Higher Education in cooperation with the Management Information Division of the Department of Finance, should (1) keep the institutions informed on the results of DMS implementation on State applications, (2) encourage cooperative efforts in system development, and if a central data processing agency is not formed, proceed with the data elements dictionary, system and programming standards, and statewide applications descriptions, (3) provide institutions with a list of selected applications and their status which appear to be candidates for adaptation to the campus' requirements, and (4) through software audits, like the hardware audits of 1971-72, develop budget sanctions for non-compliance. In addition, the Board of Higher Education should develop a software development plan for common software packages if there appears to be sufficient commonality in the applications descriptions. The institutions should attempt to fulfill software needs from public domain developments, vendor provided software, or proprietary software where it appears cost-effective.

All major software developments should have a development plan giving objectives, schedules, and costs before commitment of resources to any software development project. The Task Force strongly recommends that the institutions use such a plan to evaluate the cost/effectiveness of any proposed systems and that a specific period, e.g., three years, be adopted as a statewide standard for payout for the return on investment for any new computer application. Software developments can be managed, and the institution, not programmers, should determine appropriate priorities for use of the institution's software systems development capabilities.

As soon as there is a central data processing agency for higher education, presumably the public-interest corporation, it should be given a significant portion of the software development responsibilities described above.

Hardware Selection

A cross current which has led to high costs in public higher education has been the policy of relying almost entirely upon sole source procurement of computer hardware. The computer vendors have profited from the fact that computer purchases have been institutionalized rather than a statewide function. As a result, it has been a relatively simple matter to upgrade an installation without, in many cases, adequate cost justification, thus creating a walk step for the particular vendor whose machinery was installed. In the case of the public senior institutions, this has led to the 100% dominance of the wholly State-funded computer market by IBM.

A good deal of funds have been expended by the institutions to take "advantage" of higher educational discounts existent before June, 1969. This has led to upgrades in equipment at a time when utilization statistics indicate that such upgrades were unnecessary and in some instances, has led to a reduction in service until additional funds could be expended to convert to the greater capacity machine. Estimates of such conversion costs, however, were rarely included in the comparison of the cost of existing and the proposed [illegible]graded computer.

Such a situation is healthy neither for the vendor or the user. Computer acquisitions should be based on competitive bidding. With smart shopping, institutions can obtain comparable or better performing equipment at lower prices. For example:

> "With more than a dozen independents now offering products, competition in the IBM 360 main memory add-on market is so intense that one supplier calls it "an auction." Front-runner Data Recall a year ago quoted 18% below IBM's price for a typical 360/30 add-on. It now offers 30% off. Others

> go below this. Electronic Memories and Magnetics entered the market last fall with prices up to 35% below IBM rental, and Itel says its prices on 360/65 add-ons are below half the IBM figure."[2]

The Morrison and Rooney Associates, Ltd., report shows that 5 to 10% can be saved by acquiring non-IBM peripheral equipment such as tape drives, printers, and direct access storage units. There are, however, several criteria to be considered in evaluating vendors besides price and performance:

- .. Vendor support and service in sparsely populated areas where several large institutions are located.
- .. Educational allowances and discounts.
- .. Contractual arrangements.

While the savings at any one institution may not be large, there can be considerable savings statewide. But statewide savings can only be achieved through a centralized purchasing arrangement which is not currently possible within the higher education system. Without such an arrangement it can be expected that the computer vendors will continue to market institutionally, as has been the case with IBM since the FY73 budget recommendations, to the detriment of the State as a whole. A cooperative purchase arrangement as a function of the public-interest corporation could make these savings a reality by:

- .. Requiring the vendors to deal statewide.
- .. Adopting competitive bidding for computer acquisitions.

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[2] "Crowded Memory Market Producing Bargains," Datamation, February, 1972, p.8.

Conclusion

It is hoped that the general rationale and the specific alternatives presented herein will be useful both in planning for an organizational structure and mission, and in the development of operation plans for interinstitutional sharing that will benefit Illinois higher education. Specific studies of demand for each recommended service should be made. Equipment selection and installation, and staff training and organization must occur within the basic organizational development. But, the plan is modular. Economically feasible systems for interactive terminal service and student batch processing can proceed relatively free from requirements for administrative data processing or general computing support.

Of utmost importance to the implementation of any of the ideas presented herein, or modifications of them, is the participating of top-level administrators in the development of policies for effective inclusion of the computer resource in education. Without such a commitment, any developed plan will probably be oriented toward technical proficiencies rather than educational demands.

The final ingredient to effective implementation will be the development of an adequate management team for the project. As noted throughout this report, the resources necessary for applying computers to education are large. Therefore, they have to be managed well. But, beyond that requirement, a failure to effectively implement a statewide plan is even more costly. There will be problems, of course. But, if the problems are not solved, they will drive institutional users back to a parochial attitude of requiring complete computer support on campus -- a position the Task Force feels will be more costly and less effective than that proposed in this report.

APPENDIX A

REACTIONS TO RECOMMENDATIONS AS PRESENTED IN MP-III

I. Illinois Junior College Board

The proposed learning resource network and proposed State computer network are most appropriate in view of limited tax revenue available to support these programs, and both networks should be developed through appropriate consultation with institutional and systems staffs.

II. Gerald W. Smith - former Executive Secretary of Illinois Junior College Board

Given the present development of this technology and the delivery systems available, these recommendations appear to be reasonably satisfactory. It is my judgment that no institution nor group of institutions can afford the costs for great expansion of computer equipment and services within the present development of the technology. Every effort should be made to hasten the day when the educational and business communities can take much greater advantage of the potential of computer services by subscribing to them through a commercial agency which will make the hardware available in a system similar to our present telephone and telegraph systems. The existing small systems are too expensive and too limited in the services that can be rendered to merit expansion beyond that necessary for continued study, research and experience with this great electronic servant.

III. Board of Governors of State Colleges and Universities

Recommended - That the inter-institutional cooperation proposals be modified so as to delineate areas of joint activities which have some real promise of achieving a better and more economical total higher education enterprise.

Recommended - That in the proposed cooperative approaches the unique roles and missions of the different institutions and systems be recognized and not compromised.

Recommended - That in the proposed cooperative approaches the principle of institutional and system responsibility and initiative be emphasized and the needed central coordination component be placed in proper perspective.

IV. Board of Regents

The Board of Regents has studied certain aspects of providing computers for its universities in considerable detail. The recommendations presented here appear to be appropriate and should be supported.

V. University of Illinois

The study of the computer needs, resources, and plans of Illinois institutions of higher education would seem to be potentially a very promising undertaking. Both in terms of equipment and of manpower costs -- as well as improvement of the capabilities of institutions lacking both -- the possibilities for interinstitutional cooperation should be fully cultivated.

The University commends the approach followed in developing the recommendations in this field, viz., through having both private and public institutions participate in the work of the committee primarily responsible for the proposals (the Board's Computer Based Resources Advisory Committee).

Recommendation 23 (p. 78) - Develop a plan through appropriate committee involvement for statewide computer resource coordination.

University of Illinois position: Strong endorsement. The University commends particularly the suggestion that a review commission similar to the Commission of Scholars be established in the computer field (p.78).

Recommendation 24 (p. 78) - Address the needs for faculty training.

University of Illinois position: Endorsement.

Recommendation 25 (p. 78) - Identify areas for joint development of computer systems. The plan will recommend the best way to achieve joint development in these areas. Where joint development is not possible, the plan should specifically state the reasons.

University of Illinois position: Endorsement.

Recommendation 26 (p. 78) - Establish a Computer Equipment and Services Review Task Force to provide technical assistance to the Board of Higher Education staff in its review of proposals for expansion of computer equipment and services.

University of Illinois position: Endorsement, with the understanding that the proposed task force or commission be given adequate technical assistance.

VI. Summary of Oral Testimony and Written Statements - Carbondale

A group of student representatives stated that sharing and exchanging resources would be detrimental to undergraduate education; that institutional competition improves programs. Further, they felt regional councils would be further bureaucracy and red tape in higher education. Also, the students felt that a learning resources network was not acceptable and a computer resources network should not be recommended.

APPENDIX B

BOARD OF HIGHER EDUCATION MORATORIUM ON COMPUTER EXPENDITURES

For Presentation at the June, 1971 Board Meeting - Re: Computer Resource
Planning

WHEREAS, The Board of Higher Education has approved the recommendations of the Board's Computer Based Resources Advisory Committee on February 2, 1971; and

WHEREAS, That report indicated that the present status of computing resources was adequate to provide for current requirements; and

WHEREAS, The Board of Higher Education approved the development of a Statewide Computing Plan to be submitted by December, 1971; and

WHEREAS, The Board has indicated the priority which this plan holds both by virtue of its approval in February and its incorporation into Master Plan-Phase III;

NOW, THEREFORE, BE IT RESOLVED, That the Board of Higher Education does hereby adopt the following policy:

> Public universities, colleges and campuses under the jurisdiction of the Board of Trustees of the University of Illinois, the Board of Trustees of Southern Illinois University, the Board of Governors of State Colleges and Universities, and the Board of Regents are requested to refrain from making new or additional expenditures for any type of computing resource including, but not limited to:
>
> a) computing equipment and hardware;
> b) personnel services;
> c) contractual services; or
> d) any other type of computing resource.
>
> This request should become effective on July 1, 1971, and extend throughout the time during which the Statewide Computing Plan in being developed. No acquisition of computer equipment should be made or ordered after July 1, 1971, and only those commitments made as of this date should be honored. It is further requested that this policy apply to internal expenditures and not be limited to new requests for such items under 8, 9, and 10 of the current budget format. Further, the Board requests the Illinois Junior College Board to take similar action at its June, 1971 meeting by withholding the expenditures of any portion of its FY72 State appropriation on such computer resources, and that each Junior College President be requested by the Illinois Junior College Board to cooperatively comply with the intent of this resolution. The Board recognizes that exceptional computing needs

may arise which will necessitate the acquisition of additional computer resources, and accordingly, where such circumstances exist, the Board will review and make recommendations based upon identified needs.

Approved this _______ day of ________________, 1971,

by the ILLINOIS STATE BOARD OF HIGHER EDUCATION

__________________________, Chairman

APPENDIX C

REGNER REPORT
SUMMARY OF FINDINGS AND RECOMMENDATIONS

I. Findings

1. Public senior universities have adequate computer facilities for both administrative and academic needs without further up-grading for FY72. In fact, expansion which has occurred in the past two years exceeds the capacity to achieve effective and optimal utilization.

2. Of the thirteen senior universities, seven have installed larger computer systems during FY71. This fact alone will cause an increase in machine costs in FY72 since funds expended this year cover only a partial year of operation for the new systems. There are no other substantial requests for new equipment for FY72. Documentation for this massive up-grading in FY71 which will be further reflected in FY72 was not found in this survey.

3. Some up-grading of installations was based on long-standing orders which involved discounts which would not be available on a later order.

4. Average cost per student in ten representative institutions for administrative applications was $36, while the average cost per student for instructional uses was $17 in the same institutions. (Based on State share only.) This indicates that for most institutions instructional applications cost a little more than half the cost of administrative data processing on the average, although there is a wide range in practice. In only one university did the State share of instruction cost per student exceed that of administrative costs by any substantial amount.

5. Educational programs involving the use of the computer in instruction, or computer science courses are usually developed by and for specific departments, e.g., mathematics, engineering, accounting, etc. In some instances, these programs are tied to a particular machine configuration.

6. Most institutions stressed the need for interactive terminals for student programs. Some already have a number of such terminals.

7. It is a general practice for universities to have one or more remote batch I/O stations located on-campus for student use.

8. Computer facilities include a number of smaller or special purpose computers, on most campuses. Some smaller computers are used for parallel applications with the larger facility.

9. Administrative applications are still in need of further development on many campuses. In several instances there is considerable support of administrative systems through unit record equipment in spite of the presence of a large computer facility.

10. Line item budget, determined by program planning techniques, has not been employed by any of the institutions in the study which makes comparative assessment of the performance of the centers difficult.

11. Analysis of the utilization of computer facilities is complicated by a lack of uniform reporting of computer usage, among institutions, or in some cases the absence of such reports.

12. The analysis of public junior colleges was eliminated from this report because of the incomplete response to the survey.

II. Recommendations

1. In view of the unanimous findings of the task force that the universities have more than adequate computer power, the total cost for each institution should be reviewed and a ceiling placed on expenditures for the year FY72, approximately equivalent to last year's expenditures. Installations with higher costs due to the acquisition of new equipment should attempt to realize economies as suggested below.

2. An intensive study of system utilization was carried out at two institutions. It is recommended that this mode of operations and utilization study be extended to all public senior universities to assist computer center directors in the efficient management and planning of their operations, and in order to help them in the re-allocation of resources.

3. The possibility of savings through a study of the cost of certain peripheral equipment, small computers whose applications could be absorbed by the main facility, remote entry terminals, and terminal costs in general should be explored.

4. The computer network concept be approached not only from the standpoint of shared hardware and backups, but from that of shared expertise, program development, and educational design.

5. The State of Illinois as an educational leader in the use of computer technology can and should support national developments, such as WICHE, but at the same time it should meet the needs of its own institutions of higher education in their immediate problems of both administrative data processing and computer-augmented instruction.

6. Guidelines should be established for the acquisition of new equipment which should include:

   a) A method of cost justification based on predetermined standards.
   b) A fully documented demonstration of the need and ability to implement the programs, both academic and administrative, for which the equipment is required as support.
   c) The impact of the cost of this equipment on more than one year's expenditures.
   d) The compatability of the acquisition with total planning for all institutions of higher learning in the State.

7. Systems of Governance should have the responsibility for assuring that computer acquisitions by individual campuses be consistent with the established State of Illinois practices[1] as well as the guidelines above.

8. There should be an implementation of line-item budgeting coincident with program planning techniques which will allow a more intelligent review of computer expansion plans for institutions of higher education.

III. General Observations

An analysis of the responses to the questionnaire plus consensus conclusions from the site visits of the task force lead to the following recommendations.

(a) The concept of a base budget that requires only justification of new projects should be discarded and replaced with a method requiring justification of all projects and programs, both current and future, in the computer and data processing functions. Technological advances in equipment have allowed much faster and, therefore, less expensive operation, but the institutions and the State have not realized any savings because of the substitution of other programs which, because of the availability of funds, have not required any serious consideration, justification or approval.

(b) All University Computer and Data Processing installations should implement a recharge billing system to remove the operations as administrative overhead and put the costs into the functions and departments being serviced. These functions and departments should, therefore, follow state budgeting practice with an EDP line item in their budget request to their own administration and to the Board of Higher Education.

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[1] Chapter 127, Section 135.7, Illinois Revised Statutes

(c) Instructional usage of all joint usage computers (all but the University of Illinois) should be increased with better and more highly developed curricula and programs. An aggressive program designed to procure outside funding to relieve pressure on the resources of the State of Illinois should be developed. This is common practice in other states and in private institutions and there is no reason for the lack of such a program other than it has not been necessary in the past.

(d) Better fiscal systems utilizing computer processing should be developed to aid the institutions in the now-present era of tighter funding and support from the State. We make this observation because the typical response to questionnaires and visits is that only Payroll is processed in the business area and then only because the Auditor of Public Accounts forced the institution to do so. In the institutions where other business operations are conducted, the applications are archaic and uncoordinated.

(e) It is the consensus of the Task Force that there has existed serious gaps in the area of executive policy making and direction relative to computer selection and acquisition programs. We feel that most of the computer acquisitions have occurred in a planning vacuum and in some cases on some very questionable grounds. In more than one instance the determining factor has been the availability of price concessions on the part of vendors, which theoretically accompanied the recent unbundling movement. In a sense we concluded that institutions felt they were saving money by acquiring larger and more sophisticated hardware, even though the demands were not present and in most cases there were insufficient qualified personnel to make effective utilization of the new configurations.

(f) Coincident with this apparent unplanned and uncontrolled acquisition program has been the recurring conversions that have been necessitated. In more than one instance the staffs in the institutional centers have been involved in constant conversion of applications to the new systems, at the expense of an orderly development program which could make effective and substantial use of the equipment.

(g) In the area of student uses of the computer systems, we can raise many questions. Admittedly, this is a controversial area and perhaps is outside the scope of the Task Force efforts. However, we would be remiss to ignore the impact that uncontrolled use of the computer by students has created. Several individuals at the institutions we visited observed that the major reason for the continued upgrading to larger systems was the increasing student demand which was saturating the systems. We would not quarrel with encouraging and perhaps accommodating increased student usage.

(h) In all institutions visited, there were possible economies that could be achieved if the institutions would seriously review all of their equipment needs in light of what they were attempting to accomplish. Multiple computer configurations, high speed peripheral devices excessive terminal installations all are contributing to the spiraling costs of university computing. In most cases there appears to be no real justification for their retention at least in light of the utilization figures which we reviewed.

(i) It is the consensus of the Task Force that serious consideration must be given to the development of statewide guidelines relative to computer acquisition in the university environment. It is our considered opinion that the past two years have been banner years for the acquisition of larger and more sophisticated equipment. To retrench at this point in time could be disasterous and very costly. However, we are convinced that history should not be allowed to repeat itself.

Presently, we feel that there is no institution (except for the two new campuses) which is underequipped. On the contrary, we feel that, if anything, the reverse is true.

(j) We see no reason for any additional funds being allocated for new projects for FY72 or until such time that the institutions have complied with the preceding recommendations. The only justification for additional funds is in salary increases for currently employed personnel and to maintain current support levels. Filling of vacant positions in the existing budgets should be approved only if critical for current programs and no vacancies should be carried into FY72.

APPENDIX D

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THE STATEWIDE PLAN FOR COMPUTER RESOURCES IN ILLINOIS HIGHER EDUCATION

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Task Force for Statewide Computer
Plan Development
November 23, 1971

Background

The Illinois Board of Higher Education with the cooperation of the institutions of higher education has been studying the use of computer resources for higher education. The institutions want to be assured that the allocation of resources to computing activities is commensurate with the benefits; they both need additional computing services and would like to reduce the current cost. Public officials are concerned about the high cost of these resources to the state for the apparent utilization of the facilities.

Similarly, other institutions throughout the United States have been conducting studies. As a result there have been a number of public-interest corporations, cooperative arrangements, and reassignment of resources within institutions to effect either additional services or reduced costs.

This study has indicated that:

- The applications of computers in higher education require large installations to achieve low unit costs. This arises primarily from the richness in services which is required to service instructional, research, and administrative requirements.
- There is a wide difference in unit-costs for computing within Illinois, primarily because institutions have been unable to fully utilize available equipment or services, or reach a minimum efficient size of computing facility.
- Although current development programs, particularly administrative applications, are generally oriented toward the appropriate objectives, the effort is diffused among many institutions resulting in high total costs and delays.
- The same computing services for public higher institutions could, through a network design and cooperative operation, be provided for less than the $13.6 million projected. Greater savings should occur after further consolidation.
- Computing services for private institutions and community colleges could be provided for a nominal to a substantial savings.
- Higher education will need to make a substantial investment, estimated at as much as $150 million, in computer based education systems to meet the projected need in 1980.

The study continues in order to provide the detailed analysis and recommendations for a major cooperative effort to:

- Achieve improved cost performance.
- Improve the quality and responsiveness of computer services.
- Avoid high future costs from a diffused effort, and control current expenditures.

.. Insure the rapid implementation of

  .. computer-based educational programs, and

  .. integrated management information systems based on secure, accurate, and responsive data management systems.

General Recommendations

There are some general recommendations which appear evident at this time. These include:

.. Creation of a public-interest corporation to provide general computer services to public senior institutions, and to provide, as needed and desired by the institutions, the same services to private institutions and to the community colleges.

.. A network so that a wide range of interactive languages, remote instructional and research computing services, and administrative systems are available equally to all institutions within the state.

.. Implementation of a data base management system for institutions of higher education as a method of reducing data storage and retrieval costs, and to significantly reduce the maintenance cost of administration applications.

.. Improved allocation of computer resources so that there are appropriate mixes of skilled personnel, equipment and service access to meet computer service demands.

.. Cooperative development of administrative applications.

.. Use of economic incentives insofar as possible to encourage efficiency and control expenditures.

Public-Interest Corporation

There are a number of alternative organizations to implement a statewide computer plan. These included:

.. Placing all computer operations under a state agency -- either existing or newly created.

.. Placing all operation under an executive staff reporting to the Board of Higher Education.

.. Placing operations within regions based on governing board control.

.. To contract collectively or individually with commercial organizations for the necessary services.

.. To encourage the universities and colleges to cooperate among themselves.

.. To continue the present course.

.. To create a public-interest, not-for-profit education corporation to provide all computer services.

In recommending a specific form of organization, it is necessary to consider institutional autonomy, accountability to the public or institutional trustees, and responsibility of the public-interest corporation. The strength of higher education has been its traditional autonomy in selecting appropriate content and methods of instruction, determining the research program, and achieving an appropriate level of community service. This autonomy is expressed, in part, in the wide range of instructional programs offered students. Any organization providing computer services must be able to respond to this requirement for a wide range of services, and reflect the changing priorities of the user institutions, particularly during periods of limited resources. For this reason, the service agency should be controlled by the users.

In order to have the long-term stability needed to procure assets, the organization must have legal standing. While cooperative projects without legal structure could be executed under the aegis of a particular institution, it is not possible to maintain broad user control while the legal responsibility rests with a specific host institution. Thus, a voluntary cooperative arrangement, while it has the advantage of requiring no new entity, does not provide concomitant authority and responsibility which a corporate form provides. Furthermore, experience has shown the difficulty in sustaining a voluntary cooperative effort over a long period of time, particularly when there is separate institutional control of assets and staff, and the resulting divided loyalties.(1)

Regionalization within a governing system represents a consolidation and economy for public senior institutions. However, this approach is less satisfactory for private institutions and community colleges since there is no mechanism for user control. Also, analysis to date indicates that two applications -- interactive computing and student express service -- requires a larger economic unit than such a region provides, and there would be considerable duplication of communications. On the other hand, management problems within such a region may be less than those encountered in a statewide network.

There is, perhaps, some merit to placing all computer operations under an executive staff reporting to the Board of Higher Education. However, the non-board members of the Task Force feel that it is inappropriate for a coordinating board to be operating a service organization. During the period of transition and the first few years of operation, it will be necessary to control data processing expenditures made outside the proposed public-interest corporation. The Board of Higher Education is the appropriate agency for this budget and expenditure review for public institutions. But at the same time, there will be legitimate requirements for computing support, particularly dedicated computing facilities, which may not be best provided by the proposed computer services corporation. The Board can recommend such outside expenditures based upon a technical review, but not control, of the public-interest corporation.

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(1) For history of higher education computing networks see "Computer Networking: Experimentation in Higher Education", Jack A. Chambers, etal, Computer Research Center, University of South Florida, Tampa Research Report No. 71-1.

Thus it appears that a public-interest corporation has the desired characteristics. As a not-for-profit corporation, it has the legal powers necessary to acquire assets and conduct business. Since the institutions can be represented on the Board of Directors, there is an appropriate mechanism for general policy control by the user community. Since it is not controlled by or responsible to a specific institution, it provides the independent status for stability and long-term operation.

The long term interests of the state and institutions can be protected by provisions within the articles of incorporation for disposition of the assets should dissolution be desired at some later time.

The public-interest corporation will be entirely self-sufficient in funding. It will charge for all services, using the revolving fund approach. As a corporation, it will be able to borrow money to finance equipment purchases. This method of financing will:

.. Smooth the fluctuations of operating costs.

.. Reduce the costs, and charges.

.. Provide the capability for proceeding more rapidly with large projects such as computer-based education systems.

.. Because of its large constituency and required large computers, result in the lowest overall cost to both the state and to private institutions.

Since funds for data processing at the public senior institutions will be budgeted to the institution, the decision on the appropriate level and mix of computer services will be made by the institution.

Since the public-interest corporation can purchase equipment, it will be possible to transfer equipment to the corporation and provide the institution with a corresponding level of service credits or reimbursements. Since some equipment will remain on some campuses, the corporation becomes, at least during the transition period, a third-party "leasing" agent for equipment operated by the institution. However, there is a flexibility on the assignment and use of purchased equipment which is not now available since inter-institutional transfers may be difficult.

The corporation, as a computer utility, can select a rate structure which maximizes equipment utilization. For example, there should be very low rates for night and weekend processing to encourage full use of the computer capability. There is evidence that both faculty and students will take advantage of the lower rates. Weekend rates could approach the marginal cost of operation rather than the fully allocated costs, hence avoiding the phenomenon of users with work and idle computing capacity which now occurs under the traditional federal average cost policies.

Control of the Corporation

The corporation could be established by the public senior institutions themselves. They have the legal authority to act at this time, and only through their active support and cooperation can it achieve success. As a result, the initial impetus and direction must come from these public senior institutions. Community colleges and private institutions can contract with the corporation for its services as soon as it is operational.

The Board of Directors will represent, at the policy level, the users. A possible board with 13 members could be as follows:

(1) A student.

(2) A representative of the Faculty.

(3) A representative of the public or alumni.

(4) The Chairman of the Board of Higher Education.

(5) The Executive Director of the Board of Higher Education.

(6) A representative from the Board of Regents -- preferably either a President, a Board Member, or the Board Executive.

(7) As in (6) for the Board of Governors.

(8) As in (6) for the Junior College Board.

(9) The President of a private institution.

(10) The Chief Executive Officer at Southern Illinois University.

(11) The President of the University of Illinois.

(12) A representative of the state government, for example, the Director of the Bureau of the Budget.

(13) The President of the public corporation.

This type of board would protect the interests of the users, particularly until the corporation has an established reputation for service and the economic market mechanism becomes effective.

The Economy of Scale

There is, of course, an underlying economic concept for centralization. Fundamentally, computer power comes in the large economy size. For example, it appears that the smallest economic interactive terminal capability is from 320 to 480 terminals. This arises from the instructional need for a variety of languages. Instructors have indicated the need for APL, BASIC, Fortran, PL/I, a CAI language like Coursewriter or Planit, and a text editor. If the economic size is achieved, this service can be achieved for 25¢ to $1.00 per terminal hour. At the present time, fully allocated costs for such service vary from several dollars to several hundred dollars per terminal hour because of the low equipment utilization resulting from having only a few terminals on a large computing system. Similarly, the Plato system is designed to support 4,000 terminals for each system. These are two examples of the necessary scale to achieve economic operation -- clearly beyond the needs of any single institution.

A similar observation can be made about telecommunications. Typically each terminal is now connected to remote computing center by a voice-grade telephone line. Yet even forty typewriter terminals operating a maximum rated speed cannot produce sufficient data to fill the capacity of a single voice-quality telephone if appropriate concentrators and modems are used. Thus an appropriately designed data communications network can significantly reduce unit communications costs.

Less obvious reductions of unit costs can be made in the traditional batch processed student, research, and administrative applications particularly if the unused capacity of computers supporting interactive and express-student services can be used.

There is another economy which can be achieved in administrative applications. It is becoming clear, from the experience of the state's data processing effort, that the use of data base management systems can reduce programming and program maintenance costs. These software systems permit programs to access and manipulate data without regard to a specific file structure. This means that changes can be made to the definition and structure of the underlying data base without requiring program changes. Institutions are finding, as they begin to have a large number of computer programs, that maintenance becomes a significant factor since each change in the data base (or file structure) requires changing a large number of computer programs. These programs have to be both modified and tested, absorbing a significant amount of programmer resources and computer time. Thus as institutions have increased the number of automated data processes, they have discovered that an increasing amount of the resources are being expended merely to maintain the current level, and further development just cannot be sustained. Unfortunately current data base management systems require large-scale computing systems, and are not typically available to institutions.

Thus, in order to have the variety of computing services necessary to support a quality instruction and research program, and to achieve long-term economies of administrative data processing, large-scale installations are required. These installations become economic only when there is a large demand for service which, in turn, can only be obtained by combining the workload of several or many institutions.

Shared computing then should improve the level of service, particularly by providing a wider range of capabilities, and should significantly reduce unit costs.

There also appears to be significant economies to be achieved by cooperative or central development of administrative software. This will probably be achieved in the future because of the long-run efforts of the institutions, their governing boards, and national projects like the National Center for Higher Education Management System at WICHE. At the present time neither commercial enterprises or sponsored developmental projects have produced software packages which are widely used. However, because of cost and time pressures, several institutions in Illinois have used or adapted such software packages with significant savings in cost and time.

The Board of Higher Education and other state and national agencies are encouraging a better definition of data requirements and inter-institutional cooperation in administrative systems. These efforts are identifying both the underlying commonality and the subtle differences between institutions administrative data processing, and should lead to generally applicable administrative software systems. As these become available, there should be significant savings.

These economies of scale do not mean, however, that a marked reduction in data processing expenditures will immediately occur. First, there will be an improvement in service which will improve the quality of instruction and research. Second, there will be continuing reductions in unit costs which will permit institutions to accommodate increased enrollments and computer use without proportional increases in total costs. Third, there will be improved administrative applications which should provide improved data for institutional administrators, governing boards and trustees, and state officials. Fourth, there will be a long-run stabilization of computing costs since significant increases in capacity can occur within present levels of expenditures. One such plan is illustrated in Figure 1. Should it be necessary to reduce current expenditure levels, this can be done while maintaining or improving the level of service, but it defers some improvements in instructional quality and administrative capability. Because of the technical base of the Illinois economy, this deferral may not be desirable, and an improved administrative capability may be important to the long-run viability of the institutions of higher education.

Implementation of the Public-Interest Corporation

After the public-interest corporation is formed, the responsibility for planning and implementation rests with the corporation and its Board of Directors. However, it will be desirable to consider a specific implementation plan in order to demonstrate feasibility and to provide the corporation with sufficient planning base so that implementation can proceed immediately.

In order to provide a capability for the 1972-1973 academic year, the Task Force recommends: The creation of the corporation by the Senior Universities, and implementation of the first phase of the organization plan by July, 1972.

The corporation would:

.. Be not-for-profit.

.. Operate such computing equipment as necessary to provide services -- on-line and off-line, interactive and batch -- to all public senior institutions and to such community and junior colleges, private institutions of higher education, school boards, and eligible government agencies as may desire to purchase such services.

.. Own or lease all computer and peripheral equipment used for computer services of any kind in all public senior institutions of higher education in Illinois, and when appropriate and desired by the institution, for private institutions and community and junior colleges. (The corporation would purchase all institutionally owned equipment and provide either service credits or reimbursements.)

.. Charge for these services on a revolving fund approach with annual prices which are intended to be lower than any available from any responsible commercial organization.

.. Hire and direct a staff to:

(a) Manage the corporation as directed by the Board of Directors of the public-interest corporation.

(b) Operate the equipment.

(c) Provide system software support and maintenance.

(d) Develop all central software and data bank systems.

(e) Ensure that the data of each institution while in the corporation is secure.

(f) Coordinate any new statewide systems for management, research, education, or funding.

(g) Coordinate, as appropriate, modification and development by specific institutions.

(h) Act as a technical review agency for the Board of Higher Education for all contractual services of any kind associated with information systems already budgeted under the EDP line-item in the public senior institutions.

In order to achieve this initial implementation, the public senior institutions would enter into contractual arrangements with the corporation. These contracts should:

.. Leave ownership of the data and direction concerning its use with the institutions or agencies creating the data.

.. Leave responsibility for accuracy and completeness of the data with the institutions or agencies creating the data.

.. Establish fixed rates for each level of service and priority for the first year of operation.

.. Relegate responsibility for central systems development to the corporation and for modification and implementation to the institution.

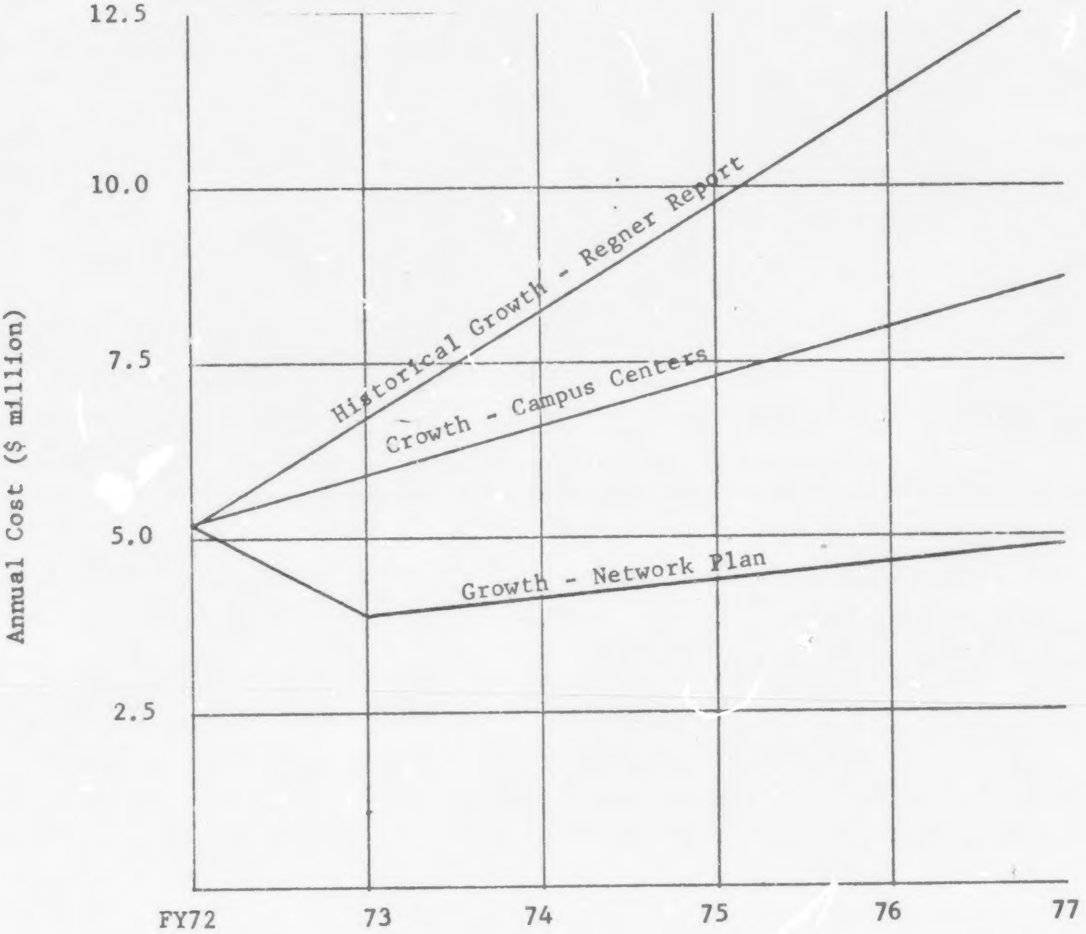
.. Transfer hardware, software, and system assets to the corporation and assign all current contracts to the corporation in exchange for service credits or reimbursements.

.. Maintain institutional responsibility for the EDP budget line-item for computer equipment and related services.

These suggested actions provide for the corporation and its purpose, and the initial steps of implementation. Because of the participation of the institutions and state agencies in this study, it is expected that should the concept of a public-interest corporation be adopted, the resulting implementation will likely be similar to that proposed.

FIGURE 1

PROJECTED ANNUAL EQUIPMENT COSTS*



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[*] Historical growth of 39% for 2 years from Report for EDP Budget Review for Universities, (Illinois) Department of Finance, Springfield, Illinois, 1971, Table 2. The Campus Growth Plan assumes every campus upgrades each central processor; some economy of scale and improved cost performance is obtained. The cost data for the network plan is based on an IBM preliminary study which may overestimate institutional requirements and further cost savings may be realized. After 1977, the first purchased machine has been paid out, and cash flow is reduced.

TABLE 1

ESTIMATED GROSS COMPUTING CAPACITY*

	ANNUAL COST	COMPUTER EQUIVALENTS**	COST PER COMPUTER EQUIVALENT
Current	$5.3 million	18.8	$281,000
Network	4.0	28.3	141,000
1977 Growth	8.6	46.6	185,000
1977 Network	4.9	58.3	84,000

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* Based on a preliminary plan submitted by IBM. The growth plan suggests larger central processors on every campus and, compared to recent growth, is quite conservative.

** Capacity expressed in IBM System 360 Model 50I with extended core storage based on benchmark data for typical batch processing.

APPENDIX E

REPORT OF JOINT COUNCIL ON HIGHER EDUCATION

Approved, Jt. Council 1/3/72

Approved, SBHE 1/4/72

OUTLINE FOR THE INITIAL RESPONSE OF THE PRESIDENTS OF ILLINOIS PUBLIC SENIOR INSTITUTIONS OF HIGHER EDUCATION TO THE PROPOSAL FOR A "PUBLIC CORPORATION FOR COMPUTERS IN EDUCATION"

I. General Background

1. The Board of Higher Education in Master Plan - Phase III approved a recommendation of its Computer Based Resources Advisory Committee for the development of a plan "for statewide computer resource coordination" among institutions of higher education.
2. As a step towards implementation of this recommendation, the Board of Higher Education on June 1, 1971, approved a progress report of its staff outlining detailed proposals for the development of the statewide plan for computer resources in higher education, including the establishment of a committee structure and a deadline of December 7, 1971, for the presentation of the completed plan to the Board of Higher Education.
3. In order to provide technical assistance to the several committees and to the Board's staff, financial assistance was secured from the Illinois Department of Finance (Management Information Division) for the support of two related projects: a detailed study of current computer installations and plans of the public senior institutions; and the development of a statewide plan by a special Task Force with joint participation of representatives of the Board of Higher Education and the Department of Finance.
4. Two sets of products have resulted from these studies:
    a. A report on existing computer operations and plans issued by the staff of the Board of Higher Education -- with recommendations for organizational changes and budgetary reductions for Fiscal Year 1973.

b. A report of the Task Force entitled "Public Corporation for Computers in Education." The recommendations in that document constitute the main elements of the "statewide plan for computer resources in higher education."

5. A central element in the proposal for the "Public Corporation for Computers in Education" (PCCE) is the recommendation that the public senior institutions take the initiative towards the implementation of the PCCE as a means to long-range cooperation in the provision of computer services to institutions of higher education in Illinois.

   This recommendation was discussed at the meeting of the Joint Council on Higher Education on December 6, 1971, and there was agreement that the senior institutions would develop a constructive response to the recommendations contained in the Task Force's report.

   It was agreed also at the meeting on December 6 that the President of the University of Illinois would take the initiative in arranging for whatever discussions or meetings might be required in order to prepare a response to the Task Force's proposals.

   These steps were announced by President Corbally to the Board of Higher Education during the discussion of the Task Force's report at the Board's meeting on December 7, 1971.

6. The present document is an initial outline of the general position of the presidents towards the Task Force's proposals, with suggestions for modifications that nevertheless would achieve the broad objectives of the cooperative endeavor recommended in the report.

II. General Position of the Presidents on the Plan for Public-Interest Corporation

1. The general objectives underlying the Task Force's plan for cooperation in the provision of computer services to Illinois institutions of higher education are strongly endorsed.
2. The presidents endorse also the general recommendation that "the major initial impetus and direction" in such cooperative endeavor should come from the public senior institutions. They believe, furthermore, that these institutions should predominate in the control and direction of whatever cooperative organization or arrangements might prove to be feasible for the realization of the objectives identified.
3. The presidents are willing to cooperate in determining the feasibility of establishing a "public-interest corporation" and the possibility for it to secure on favorable terms the financial resources necessary for the realization of savings in equipment and other costs of cooperative computer operations.

   A key question to be answered is whether or not such a corporation could be funded for these purposes through the issuance of general-obligation bonds, which would require approval by the General Assembly and the Governor. There is reason to doubt that such an effort would be successful, but the presidents will explore the possibility.
4. Even if the organizational and statutory problems in the establishment of a public-interest corporation could be solved during the next session of the General Assembly, the corporation should not attempt initially to undertake all of the functions outlined on p. 2 of the Task Force's report. Its major effort should be concentrated first upon the acquisition of computer and peripheral equipment, assuming that the kinds of

savings envisioned in the Task Force's report could be realized through centralized ownership or leasing of such equipment.

5. Concurrent with the acquisition and leasing of equipment, the new organization should work systematically to develop a detailed plan for interinstitutional cooperation in the use of computer equipment, software, and technical personnel.

6. No rigid calendar for the implementation of these objectives should be established in advance. Instead, an evolutionary approach to interinstitutional cooperation should be followed, with appropriate use of pilot projects and adequate testing of the feasibility of cooperative arrangements before widespread or radical changes are introduced.

7. In the event that the type of public-interest corporation proposed by the Task Force could not be established, it is recommended alternatively that the public senior institutions proceed towards the major objectives of the report through the organization of a voluntary consortium. (The latter might even organize a corporation, if that proved to be a desirable means to assuring effective interinstitutional cooperation in the provision of computer and associated services.) The name of such an organization might be "Illinois Universities Consortium for Computer Services," or some such equivalent title. In the remainder of this outline, the term "Consortium" will be used to refer to the proposed organization.

III. Interim Plan for the Consortium -- Fiscal Year 1972

1. The consortium would consist of representatives from the institutions constituting the public senior systems of higher education in Illinois. (It would be expected that a representative or representatives from the Illinois Junior College Board and from private higher education would be added to the Consortium at a later stage.) The representatives initially would include the President of the University of Illinois and the chancellors at its three campuses, the presidents of the institutions governed, respectively, by the Board of Regents and the Board of Governors of State Colleges and Universities, and by the Board of Trustees of Southern Illinois University. The President of the University of Illinois would serve as chairman of the Consortium.
2. The Consortium would establish two task forces during January 1972, as follows:
   - a. Task Force on Organization and Mission.
   - b. Task Force on Interinstitutional Cooperation in Computer Services
3. The Task Force on Organization and Mission would have responsibility for determining whether or not a permanent organization should be established, what form it should take, and under what bylaws it would operate. This Task Force would also develop a broad operational plan for the permanent organization, for review by the Consortium.
4. The Task Force on Interinstitutional Cooperation in Computer Services would have the following responsibilities during the remainder of FY 1972:

a. Analysis and evaluation of the report of the staff of the Board of Higher Education on computer operations and associated services of the public senior universities -- with special reference to possible budgetary savings during FY 1972 and FY 1973. Available for this review would be a commentary from each campus on the sections of the BHE report relating to its own computer installations, together with any suggestions it might have for campus, institutional or statewide improvement in the utilization of computer resources.

b. The development of operational plans for interinstitutional sharing of computer resources and services. The recommendations made in the BHE Task Force's report, the BHE report on existing installations, and proposals submitted by vendors would be considered in this planning study, along with suggestions that might be submitted by the individual campuses or systems.

5. A small interim staff would be necessary to support the work of the two task forces, and to coordinate other activities of the Consortium during the remainder of FY 1972. Preferably, arrangements would be made with one or more of the cooperating institutions to release staff members for this purpose.

6. The Consortium would consider carefully the need for independent technical advice in the evaluation of both the recommendations in the BHE reports and the proposals developed by its own task forces. It is likely that such outside assistance would be

especially helpful in the fairly immediate future, and proposals for a contract should be secured by February 1, 1972 if an operational plan is to be developed this year.

IV. It should be recognized that the steps outlined immediately above for the Consortium would be taken only after the necessary approval of the system governing boards.

V. Proposed dates for implementing the work of the Consortium are as follows:

January 15, 1972 - Initial Consortium meeting

March 7, 1972 - Report to SBHE concerning proposals for organizational form

July 1, 1972 - Complete organizational arrangements

September 30, 1972 - Initiate pilot programs for interinstitutional cooperation

September 30, 1972 - Evaluation of progress by SBHE Task Force

APPENDIX F

CALENDAR OF MEETINGS

Date	Organization/Individual
1971	
April 5-6	California State Colleges
June 1	Illinois Board of Higher Education
June 2	Steering Committee
June 4	Policy/Technical Committees Vendor Representatives
June 11	Policy/Technical Committees
June 18	Policy/Technical Committees
June 25	Policy/Technical Committees
June 30	Policy/Technical Committees
July 1	Steering Committee
July 6	Illinois Board of Higher Education
July 14	Policy/Technical Committees
July 28	Policy/Technical Committees
August 4	Policy/Technical Committees
August 11	Technical Committee
September 2	Research Subcommittee
September 8-9	Instruction Subcommittee Administrative Subcommittee PLATO Demonstration
September 13	New Jersey Board of Higher Education (New Jersey Educational Computing Center)
September 14	Triangle University Computing Center (TUCC) North Carolina Educational Computing Services (NCECS)
September 15	Policy/Technical Committees
September 16	IBM Association of Illinois Junior College Presidents
September 22	Stanford University
September 23	University of California
September 24	Los Angeles Community College Coast Community College
September 25	Student Advisory Committee
September 26-27	Technical Committees and Subcommittees
October 4	Steering Committee
October 5	Illinois Board of Higher Education
October 6	PLATO Demonstration
October 12	RAND Corporation: Roger Levien U.S.Office of Management and Budget: James Hystead National Science Foundation: John Pasta

Date	Organization/Individual
1971	
October 13	National Institute of Education: Harry Silberman
	Office of Naval Research: Victor Fields
	Department of Defense, ARPA: Larry Roberts
	IBM
October 21	Policy Committee
October 27	Federation of Independent Illinois Colleges and Universities
October 29	University of Illinois: John Corbally, President
October 30	Student Advisory Committee
November 5-6	PLANIT Demonstration
November 10	Illinois State University: David Berlo, President
	Sangamon State University: Robert Spencer, President
	Board of Governors: Ben Morton, Executive Officer
November 11	Governors State University: William Engbretson, President
	Northern Illinois University: Richard Nelson, President
	Northeastern Illinois University: Gerald Sachs, President
November 12	Eastern Illinois University: Gilbert Fite, President
November 15	Chicago State University: Milton Byrd, President
November 16	Western Illinois University: John Bernhard, President
	Board of Regents: Franklin Matsler, Executive Director
November 17	Southern Illinois University - Board of Trustees: James Brown, Chief of Board Staff
	Carbondale Campus: Willis Malone, Exec. Vice President
	Edwardsville Campus: John Rendleman, President
November 19	Association of Illinois Junior College Presidents
November 20	Illinois Community College Trustees Association
November 22	University of Illinois - Medical Center: Joseph Begando, Chancellor
	Circle Campus: Warren Cheston, Chancellor

Date	Organization/Individual
1971	
November 22	Chicago City Colleges: Oscar Shabat, Chancellor
November 23	University of Illinois - Urbana Campus: Jack Peltason, Chancellor Policy Committee
November 30	Bureau of the Budget: John McCarter, Director Board of Higher Education: James Holderman, Executive Director
December 1	University of Illinois: John Corbally, President
December 2	Steering Committee
December 6	Joint Council on Higher Education
December 7	Illinois Board of Higher Education
1972	
January 3	Joint Council on Higher Education
January 5	Control Data Corporation
January 15	Illinois Universities Consortium for Computer Services PLATO Demonstration to Public University Presidents
January 24	UNICOLL
January 26-28	National Forum on New Planning and Management Practices in Higher Education
February 10	University Computing Company
March 7	Illinois Board of Higher Education

APPENDIX G

PRESENTATIONS TO JUNIOR COLLEGE PRESIDENTS AND TRUSTEES

COMPUTER RESOURCES AND THE ILLINOIS JUNIOR COLLEGES

PRESENTATION TO: Association of Illinois Junior College Presidents
DATE: September 16, 1971
BY: David F. Nyman, Illinois Board of Higher Education Staff

Computers are no longer the sole province of the technician. They are in everyday use in medicine, teaching, pollution control, economic studies, and in higher education. But -- their full potential has yet to be exploited to solve your current fiscal pressures.

The state government of Illinois, like those of many other states, is concerned that computer resources in higher education be used to their greatest potential. Illinois is particularly fortunate to have a number of highly trained and talented people, and a large amount of computer equipment available to higher education. There is some evidence that this resource could be better used to further the purpose and goals of our institutions of higher education. The nature of computing--the economic advantages of large scale computers and the sharing of major developmental expenses--suggests that computing resources should be considered in a larger context than a single institution or even a single system. Several other states have demonstrated significant improvements in computing through cooperative efforts and distributed networks.

But computing touches the essence of the educational process; computers can be teachers, computers can be a tool to the professional, computers can be an object of study, and computers can improve the administration of higher education. For this reason, the Illinois Board of Higher Education asked that institutions throughout Illinois participate in a study of computer resources and to give serious consideration to how these resources are used. Several committees have been hard at work throughout the summer on these problems and their work has been most useful. The Advisory Council represents all of the institutions and has formed the framework for the committee structure. The Policy Committee and the Technical Committee have defined the uses of computers in higher education, the requirements for computing support, and the environment for the use of computer resources. The three subcommittees of the Technical Committee have considered appropriate recommendations for Instruction, Research and Administrative Data Processing. Consultants have been retained by the Board of Higher Education and the Department of Finance to assist in this complex and technical project. Every effort is being made to have a technically sound and economically feasible plan for the next fiscal year.

Such a plan can be formulated only in the context of an understanding of the purpose and direction of the institutions of higher education. This is difficult; the institutions and the governing boards have difficulty in articulating their objectives with sufficient specificity to permit precise planning. More specifically, the computer resources study is finding an understanding of the institutions role at some future date to be the most difficult part of the effort. This self-examination by the institutions should be healthy and clearly the computer resources study will have improved resource planning on each campus.

It may be useful to examine some of the issues which are raised by applying computer technology to the educational problems of the junior colleges.

In the last few years the definition of "equal education" has changed from the responsibility of providing institutional resources to any student who qualified to providing an opportunity for equal educational achievement regardless of the student's background. This change in mission places a significant additional burden on the junior colleges which accept students with widely divergent preparations and give them an opportunity to achieve their vocational and academic goals. So far, only tutoring and computer based education have shown, as methods of instruction, the ability to compensate for markedly different levels of preparation. Thus computer technology, in the form of terminal based instruction for large numbers of students, appears to be applicable to the junior colleges.

Our technical society requires a number of technically trained personnel. The introduction of computers on a mass scale has created a demand for computer operators, programmers, and data control personnel. The computer then becomes an integral part of instruction as courses teach its operation and use. It is interesting to note that having a computer may not be sufficient. In a recent study by the Dallas Independent School District, several potential contractors suggested that the operation of computers should be done by console simulation rather than by giving students extensive hands-on experience. Employers indicated that a general knowledge of the computer as a system of integrated hardware and software, and the ability to interpret and respond to computer messages was more important than the mechanical ability to mount tapes and disks and feed cards and paper to the computer. Similarly it has been demonstrated that students learn at different rates and, thus, taking some portion of courses by computer assisted instruction may be more beneficial than the conventional methods of instruction. Thus, there is a significant issue on the type of instruction best for computer instruction in the junior colleges.

One of the recent changes in higher education is increased flexibility for the student and faculty in choosing courses, and in some cases, examinations for credit. Changes such as modular scheduling, night and weekend classes, and exchange attendance between institutions, coupled with ever increasing requirements for reporting to federal, state, and local governments, have placed an intolerable burden on institutions for administrative data processing. No institution can bear the costs of developing the software for all of these applications. But if this cost of development could be shared by several institutions, then it may be feasible to meet these increasing requirements without cost increases.

The computer is part of the modern technology. It has been both a blessing and a curse as everyone with a credit card knows. But the community must learn to understand and control the computer technology. As Reich suggested in "The Greening of America", the computer experts should share the technology with the community and the community should appreciate its role in society. This community enlightenment could be a responsibility of the junior colleges.

The junior colleges have a community service responsibility. It is not clear the bounds of that responsibility. Clearly it does not mean that junior colleges should take over the responsibility and liability for the day-to-day administrative functions of local governments. But on the other hand, computer resources may be required to fulfill a community responsibility as, for example, the school districts in Washington state provide computers for ballot counting in elections.

These issues, and their resolution, will have a significant impact on the computer resources study and the resulting system proposed for higher education.

If these issues are to be effectively resolved, we must have the help of the junior college presidents in defining the role and mission of their institutions, especially with regard to instruction and community service. I hope that you will agree to provide this aid to us by developing a short paper addressing this subject.

Similarly the issues related to the resources specially designed to support the research responsibilities and administrative needs of higher education must be resolved. Further, the results of the study should provide an economic alternative for the private institutions in Illinois. It would be unfortunate if some relief from the spiraling cost of computers can not be effected for the private colleges and universities through shared resources and cooperative action.

We hope that, at the conclusion of the study, we can say that computing resources can make a more substantial contribution to the mission of all Illinois institutions for our efforts.

PRESENTATION TO: ASSOCIATION OF ILLINOIS JUNIOR COLLEGE PRESIDENTS
DATE: November 19, 1971

By: David F. Nyman
Associate Director, Data Systems
Illinois Board of Higher Education
November 18, 1971

The Environment

The past decade has seen an overwhelming increase in the importance of higher education in our national scene. The pressures of an increasing college age population and an increasing college-going rate has placed a great demand on our higher educational institutions. Beset with these external pressures, there were great internal pressures for institutions to expand in size and scope to meet the demand for higher education. As a result, institutions have eagerly sought and accepted increased levels of state, federal, and foundation funds for research, fellowships, building programs, increased educational offerings and other uses.

One result of this period of expansion is a highly sophisticated system of higher education in Illinois and the nation. In Illinois, we have adopted the concept of the community college as an integral part of this system. As such, we are extending the opportunities for higher education, both degree oriented and vocational, to all citizens in the state.

There has been a steadily increasing application of resources over the past decade in an effort to meet the pressures of the increasing college enrollment. This, of course, has also been true in the computer area. There has been an excessive dependence on federal and foundation sources of income, particularly by the large private universities. However, since all public colleges and junior colleges couldn't compete with the large private universities and a selected number of public universities, they have demanded and received state and local support for their computing centers. Finally, those institutions that do not qualify for public support nor can interest the Federal Government have been left behind with little or no computing capability.

Now we face the decade of the seventies with new realities:

1. The growing realization that financial resources -- State and Federal -- will be increasingly limited.
2. College age population will peak in 1980, but college age no longer means the 18 to 22 age group. There will be growing demands for new kinds of educational experiences for new types of students.
3. There is a duplication of effort resources and programs among all institutions -- public and private.

As a result of these pressures, the recent issuance of MP III addressed the issue of how the State of Illinois can achieve the greatest effectiveness in utilizing its existing higher educational resources. In other words, what innovative means are available to obtain more academic programming or service without impairment of the quality of education in the system.

Statewide Computer Resource Plan Development

It is against this background that the study of computing resources in the state was begun. It is one of the first times (if not the first time) that the traditional barriers between Illinois institutions have been removed in the computer area in an attempt to provide a planned approach to computing activities.

Equal access to computing capability and equal opportunities for knowledge about computers and their applications are clearly two educational needs that fall within the Collegiate Common Market concept as espoused in MP III. This is surely not the current situation. Analysis of data collected as part of the current study indicates that student exposure to computing at institutions with computers ranges 0.7% to 55%(1) of the student population. Cost per student for instruction ranges from $7.00 to $693.00(2). These figures indicate a wide range in the effectiveness of resource utilization. The picture for administrative and research computing is comparable. Sensing this distribution, the Board of Higher Education directed that a Statewide Plan for Computing Resources be developed that would include both public and private institutions of higher education.

As a result, the Board staff sought to develop such a plan by maximizing institutional involvement in its creation. Three committees were established. The Steering Committee consisted of members of those institutions interested in the plan development. Its purpose is to provide a forum for the discussion of the plan as it develops. The Technical Committee exists to determine higher education's needs for computing resources, and to design technically feasible alternatives to provide for those needs. The Policy Committee exists to select a set of alternatives for recommended implementation as the State Plan and to recommend policies necessary for implementation.

Early in the study, it was determined that due to the current financial limitations, the Board staff would have to take a more active role in the development of the plan than had originally been anticipated. Consequently, two staff members have been assigned full-time responsibility for the project. Two consultants have also been employed to aid in the development of the plan. They are Dr. R. L. Martino and Mr. James Farmer. Dr. Martino was the consultant for the development of IMPACT 70's, the computer plan for the state agencies. Mr. Farmer was responsible for the development of a computer network at the California State Colleges. The cost of these consulting services is being shared equally with the Department of Finance. Mr. John Gentile, Deputy Director of the Department of Finance, is also contributing time to the effort.

These five individuals are collectively termed the "Task Force" and it is their responsibility to insure that objective studies leading to the development of the plan are completed and that inputs from those affected by the plan are considered. Thus far, to carry out the second part of the Task Force's charge, presentations have been made to the Board of Higher Education, the Public Junior College Presidents, the Student Advisory Committee, and the Federation of Independent Illinois Colleges and Universities. Our purpose here today is similar to the previous meetings. We would like your reactions and a policy statement relative to some issues that will be presented today.

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(1) Jr. Colleges = 4-55%; Public Sr. Colleges - 0.7-32%; Private Institutions = 2-33%.

(2) Jr. Colleges = $51-$693; Public Sr. Colleges = $16-$130; Private Institutions = $37-$280.

Issues

The question is one of determining how to apply and effectively utilize the computing resources to serve the needs of the functional areas of administration, instruction, research, and public service. The resources are three: hardware, software, and human. The fourth resource, finance, is limited and must be applied to provide the first three resources in the most effective manner. The issues which we wish to discuss this morning are also three: a network of computer resources, a statewide computing institute, and computer based education.

Any statewide plan must provide a more cost/effective approach to the computing needs of the participating institutions than they are currently experiencing. Currently the feeling exists that control of computing hardware and software development aids the control of the administrative process. The Task Force believes that this belief is misdirected. Control of administrative processes lies not in the control of the "computer room" but in good management via user control, access, and interpretation of the data processed in the computer room -- regardless of the location of that room.

Current total costs for the administrative applications necessary for production of that data vary widely. Costs per student vary between $6.00 and $153.00 for administrative applications. There is no correlation between the cost of administrative data processing as a function of institutional size nor as a function of applications in a productive status. The lack of such correlation indicates either a very diverse pattern of utilization or a lack of planning and control. If the latter is true, the existence of the "computer room" and its services on campus have certainly not demonstrated its benefit in controlling its own processes.

The task force feels that the solution to the problem is twofold. First is the immediate provision of a well managed network providing administrative computing capabilities. Second, is the long range development of an appropriate Data Management System, capable of being driven by administrative users.

A second issue involves the provision for education about and using the computer. The instructional subcommittee will probably propose that by 1980, 90% of the entering freshmen should have some educational contact with the computer. The need for such percentages is not unrealistic. Dr. Edward David, Jr., Science Advisor to President Nixon, has remarked that we face the challenge of "converting the image of computers from the image of an unwelcome intruder -- a disagreeable agent of change, to the image of a benevolent helper and resource for our country". Should the higher educational community accept this challenge, the requirement of 90% of the entering freshmen is not unrealistic.

Again, due to economies of scale, providing the computing resource necessary to accomplish this task is probably best done by a network. However, there is more to this issue than the provision of computing capability. Course material will not be altered to include computer usage unless the instructors are familiar enough with the computer to do so. The Task Force feels that a statewide computing institute, perhaps using the resources of one institution, is the solution to this problem. Such an institute should be considered to have a wider mission than faculty training. Certainly there is the need to keep administrative staff current. There is also the need to think of the "customers" of the institute in a broader sense. State and industrial employees also should be considered as potential users of the services offered by such an institute.

The final consideration is how to factor computer based education (CBE) into the statewide plan. Such systems are technically feasible today. Examples are PLATO, PLANIT, and TICCET. The question is more one of demonstrating the educational viability and cost/effectiveness of these systems when compared to the traditional methods of instruction. The Task Force feels that the PLATO system is worthy of a commitment to it as the system for delivering CBE within the state. Recommendations on how this commitment should be made are still under discussion. Perhaps testing should be conducted by a section of the statewide computing institute. Certainly CBE should be considered as just one of the modes of applying educational technology to improving the educational process. Some very serious thought should be given to how all these educational technologies can best be applied to present an integrated approach to improvement of the educational process.

The way in which these issues are resolved must emanate from the institutions. The Task Force cannot see how this is possible with the current structures in Illinois. Therefore, the Task Force favors a third party approach, i.e., a public corporation governed by a Board of Directors outside the traditional institutional structure. This corporation would own all the central hardware in the state higher educational system and would provide computer services to the institutions on a charge-back basis. For such an entity to be successful, the Task Force sees that the following organizational criteria must be adopted:

The organization must
- be independent of the Board of Higher Education
- be independent of MID/DOF/BOB
- be independent of any one institution, governing system, or coordinating body
- be located off any campus
- have start-up capital
- have a developmental budget
- have flexibility to hire and fire personnel
- be on a zero profit basis for operations
- charge back for services
- recognize data ownership and data privacy of institutions
- provide service for a cost less than any outside source
- have a "captive" audience during initial years of service
- be independent of institutional budgeting process
- develop systems centrally to be tailored by individual institutions
- be controlled by an institutional Board of Directors.

Relevance to Junior Colleges

The Task Force would see an immediate implementation of this concept in FY73 for public senior institutions. Complete implementation of the concept should be achieved by the beginning of FY74 for these institutions. The private institutions have been apprised of the sharing concepts mentioned and are interested in pursuing the possibilities that such an arrangement presents. Involvement would be on a voluntary basis for these institutions. It is expected that a similar arrangement could be made during FY73 and beyond for the junior colleges.

During this study much discussion has revolved around the community service aspect of the community colleges. Perhaps some of this has been generated by a confusion over the operating, planning, and information functions performed by the data processing organization. The operating function is carried out under well-defined means and procedures. The planning function establishes goals and decides on alternate methods for reaching these goals. The information function bridges the other two functions by collecting information from the operating function and presenting it for the planning function.

There is no pressure by the adoption of this statewide plan to fix the role of the junior colleges in relation to these three functions. However, use of the network requires charge-backs for the service and the depositing of data at a central location. This requires that privacy of the data be assured and an agreement about which data can be used as information for planning purposes by which agencies.

To orient our discussion, perhaps it would be best to summarize the issues by a series of statements to you as the top executive officers of the public community colleges in the state.

STATEMENT: Some form of computer sharing will result from the plan under development. The impact of such sharing would be:

.. no reduction in the institutions program autonomy
.. a likely reduction in unit cost of computing
.. the dependence upon a data center for computer operations which can be detailed in a user-provider contract
.. use of prescribed data center standards.

STATEMENT: Training in computer sciences is required for faculty, administrative staff, state employees, and industry. It has been proposed that a computer institute be developed for this purpose with perhaps adjunct professors conducting courses off campus.

STATEMENT: Computer based education systems are coming of age after many years of development. The application of these systems must be investigated.

STATEMENT: Various institutions have developed poor to excellent applications programs such as payroll, library systems, and student registration. A more integrated approach to information systems must be taken.

QUESTION: Are the community colleges interested in participating on the Board of Directors of a public corporation which will direct itself to the statements above?

PRESENTATION TO: ILLINOIS COMMUNITY COLLEGE TRUSTEES ASSOCIATION
DATE: November 20, 1971
By: David F. Nyman
Associate Director, Data Systems
Illinois Board of Higher Education
November 20, 1971

The Environment

The past decade has seen an overwhelming increase in the importance of higher education in our national scene. The pressures of an increasing college age population and an increasing college-going rate has placed a great demand on our higher educational institutions. Beset with these external pressures, there were great internal pressures for institutions to expand in size and scope to meet the demand for higher education. As a result, institutions have eagerly sought and accepted increased levels of state, federal, and foundation funds for research, fellowships, building programs, increased educational offerings and other uses.

One result of this period of expansion is a highly sophisticated system of higher education in Illinois and the nation. In Illinois, we have adopted the concept of the community college as an integral part of this system. As such, we are extending the opportunities for higher education, both degree oriented and vocational, to all citizens in the state.

There has been a steadily increasing application of resources over the past decade in an effort to meet the pressures of the increasing college enrollment. This, of course, has also been true in the computer area. There has been an excessive dependence on federal and foundation sources of income, particularly by the large private universities. However, since all public colleges and junior colleges couldn't compete with the large private universities and a selected number of public universities, they have demanded and received state and local support for their computing centers. Finally, those institutions that do not qualify for public support nor can interest the Federal Government have been left behind with little or no computing capability.

Now we face the decade of the seventies with new realities:

1. The growing realization that financial resources -- State and Federal -- will be increasingly limited.
2. College age population will peak in 1980, but college age no longer means the 18 to 22 age group. There will be growing demands for new kinds of educational experiences for new types of students.
3. There is a duplication of effort resources and programs among all institutions -- public and private.

As a result of these pressures, the recent issuance of MP III addressed the issue of how the State of Illinois can achieve the greatest effectiveness in utilizing its existing higher educational resources. In other words, what innovative means are available to obtain more academic programming or service without impairment of the quality of education in the system.

Statewide Computer Resource Plan Development

It is against this background that the study of computing resources in the state was begun. It is one of the first times (if not the first time) that the traditional barriers between Illinois institutions have been removed in the computer area in an attempt to provide a planned approach to computing activities.

The Board staff sought to develop such a plan by maximizing institutional involvement in its creation. Three committees were established. The Steering Committee consisted of members of those institutions interested in the plan development. Its purpose is to provide a forum for the discussion of the plan as it develops. The Technical Committee exists to determine higher education's needs for computing resources, and to design technically feasible alternatives to provide for those needs. The Policy Committee exists to select a set of alternatives for recommended implementation as the State Plan and to recommend policies necessary for implementation.

Early in the study, it was determined that due to the current financial limitations, the Board staff would have to take a more active role in the development of the plan than had originally been anticipated. Consequently, two staff members have been assigned full-time responsibility for the project. Two consultants have also been employed to aid in the development of the plan. They are Dr. R. L. Martino and Mr. James Farmer. Dr. Martino was the consultant for the development of IMPACT 70's, the computer plan for the state agencies. Mr. Farmer was responsible for the development of a computer network at the California State Colleges. The cost of these consulting services is being shared equally with the Department of Finance. Mr. John Gentile, Deputy Director of the Department of Finance, is also contributing time to the effort.

These five individuals are collectively termed the "Task Force" and it is their responsibility to insure that objective studies leading to the development of the plan are completed and that inputs from those affected by the plan are considered. Thus far, to carry out the second part of the Task Force's charge, presentations have been made to the Board of Higher Education, the Public Junior College Presidents, the Student Advisory Committee, and The Federation of Independent Illinois Colleges and Universities. Our purpose here today is similar to the previous meetings. We would like your reactions relative to some issues and the proposal that we feel will resolve these issues.

Issues

The question is one of determining how to apply and effectively utilize the computing resources to serve the needs of the functional areas of administration, instruction, research, and public service. The resources are three: hardware, software, and human. The fourth resource, finance, is limited and must be applied to provide the first three resources in the most effective manner. The issues which we wish to discuss today are also three: a network of computer resources, a statewide computing institute, and computer based education.

Any statewide plan must provide a more cost/effective approach to the computing needs of the participating institutions than they are currently experiencing. Currently the feeling exists that control of computing hardware and software development aids the control of the administrative process. The Task Force believes that this belief is misdirected. Control of administrative processes lies not in the control of the "computer room" but in good management via user control, access, and interpretation of the data processed in the computer room -- regardless of the location of that room.

Current total costs for the administrative applications necessary for production of that data vary widely. Costs per student vary between $6.00 and $153.00 for administrative applications. There is no correlation between the cost of administrative data processing as a function of institutional size nor as a function of applications in a productive status. The lack of such correlation indicates either a very diverse pattern of utilization or a lack of planning and control. If the latter is true, the existence of the "computer room" and its services on campus have certainly not demonstrated its benefit in controlling its own processes.

The Task Force feels that the solution to the problem is twofold. First is the immediate provision of a well managed network providing administrative computing capabilities. Second, is the long range development of an appropriate Data Management System, capable of being driven by administrative users.

A second issue involves the provision for education about and using the computer. Equal access to computing capability and equal opportunities for knowledge about computers and their applications are clearly two educational needs that fall within the Collegiate Common Market concept as espoused in MP III. This is surely not the current situation. Analysis of data collected as part of the current study indicates that student exposure to computing at institutions with computers ranges 0.7% to 55%(1) of the student population. Cost per student for instruction ranges from $7.00 to $693.00(2). These figures indicate a wide range in the effectiveness of resource utilization. The instructional subcommittee will probably propose that by 1980, 90% of the entering freshmen should have some educational contact with the computer. The need for such percentages is not unrealistic. Dr. Edward David, Jr., Science Advisor to President Nixon, has remarked that we face the challenge of "converting the image of computers from the image of an unwelcome intruder -- a disagreeable agent of change, to the image of a benevolent helper and resource for our country". Should the higher educational community accept this challenge, the requirement of 90% of the entering freshmen is not unrealistic.

Again, due to economies of scale, providing the computing resource necessary to accomplish this task is probably best done by a network. However, there is more to this issue than the provision of computing capability. Course material will not be altered to include computer usage unless the instructors are familiar enough with the computer to do so. The Task Force feels that a statewide computing institute, perhaps using the resources of one institution, is the solution to this problem. Such an institute should be considered to have a wider mission than faculty training.

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(1) Jr. Colleges = 4-55%; Public Sr. Colleges = 0.7-32%; Private institutions = 2-33%.

(2) Jr. Colleges = $51-$693; Public Sr. Colleges = $16-$130; Private Institutions = $37-$280.

Certainly there is the need to keep administrative staff current. There is also the need to think of the "customers" of the institute in a broader sense. State and industrial employees also should be considered as potential users of the services offered by such an institute.

The final consideration is how to factor computer based education (CBE) into the statewide plan. Such systems are technically feasible today. Examples are PLATO, PLANIT, and TICCET. The question is more one of demonstrating the educational viability and cost/effectiveness of these systems when compared to the traditional methods of instruction. The Task Force feels that the PLATO system is worthy of a commitment to it as the system for delivering CBE within the state. Recommendations on how this commitment should be made are still under discussion. Perhaps testing should be conducted by a section of the statewide computing institute. Certainly CBE should be considered as just one of the modes of applying educational technology to improving the educational process. Some very serious thought should be given to how all these educational technologies can best be applied to present an integrated approach to improvement of the educational process.

The Task Force has considered a number of alternatives toward organizing to implement a statewide computer use plan that will resolve these issues. The major organizational alternatives are:

(1) To create a public corporation to provide all computer services.

(2) To place all operations under a state agency -- existing or newly created.

(3) To place all operations under an executive staff reporting to the Board of Higher Education.

(4) To contract collectively or individually with commercial organizations for the necessary services.

(5) To let the universities cooperate among themselves.

(6) To continue the present course.

The Task Force has analyzed these alternatives quantitatively and qualitatively, and has rejected each alternative except the first one, i.e., the Task Force strongly recommends the formulation of a Public Corporation for Computers in Education - PCCE. For such an entity to be successful, the Task Force sees that the following organizational criteria must be adopted:

The organization must
.. be independent of the Board of Higher Education
.. be independent of MID/DOF/BOB
.. be independent of any one institution, governing system, or coordinating body
.. be located off any campus
.. have start-up capital
.. have a developmental budget
.. have flexibility to hire and fire personnel
.. be on a zero profit basis for operations
.. charge back for services

.. recognize data ownership and data privacy of institutions
.. provide service for a cost less than any outside source
.. have a "captive" audience during initial years of service
.. be independent of institutional budgeting process
.. develop systems centrally to be tailored by individual institutions
.. be controlled by an institutional Board of Directors
.. own or lease all computer and peripheral equipment used for computer services of any kind in all public senior institutions of higher education in Illinois
.. operate such equipment to provide production services -- on-line or off-line, interactive and batch -- to all public senior institutions and to such other junior colleges, private institutions of higher education, school boards, and government agencies that may desire to purchase such service.

The Corporation must emanate from the institutions themselves. Only they have the legal authority to act at this time, and only they can achieve success. Without the active support of every President and Chancellor, there is little chance for success.

The Corporation will be directed by a Board of 13 members as follows:

(1) The President of the University of Illinois.

(2) The Chief Executive Officer at Southern Illinois University.

(3) A representative from the Board of Regents -- either a President or a Board Member selected by the Presidents.

(4) As in (3) for the Board of Governors.

(5) As in (3) for the Junior College Board.

(6) A student.

(7) A representative of the Faculty.

(3) A representative of the public, or another Junior College President.

(9) The Director of the Bureau of the Budget.

(10) The Chairman of the Board of Higher Education.

(11) The Executive Director of the Board of Higher Education.

(12) The President of a Private Institution.

(13) The President of the PCCE.

Relevance to Junior Colleges

The Task Force would see an immediate implementation of this concept in FY73 for public senior institutions. Complete implementation of the concept should be achieved by the beginning of FY74 for these institutions. The private institutions have been apprised of the sharing concepts mentioned and are interested in pursuing the possibilities that such an arrangement presents. Involvement would be on a voluntary basis for these institutions. It is expected that a similar arrangement could be made during FY73 and beyond for the junior colleges.

Conclusion

To recap, we are proposing a Public Corporation which will:

(1) be non-profit

(2) own or lease all computer equipment used for computer services in all public senior institutions

(3) operate such equipment and provide production services to all public senior institutions and to such other junior colleges and private institutions of higher education that desire to purchase these services

(4) develop application systems capable of being institutionally "tailored" for statewide implementation

(5) charge for these services on a revolving fund approach.

These concepts were presented yesterday to the Council of Junior College Presidents who passed a motion expressing a desire to be represented by at least two public junior college representatives on the Board of Directors of the Public Corporation for Computers in Education.

APPENDIX H

PRESENTATION TO THE FEDERATION OF INDEPENDENT ILLINOIS COLLEGES AND UNIVERSITIES

By: David F. Nyman
Associate Director, Data Systems
Illinois Board of Higher Education
October 27, 1971

The Environment

The past decade has seen an overwhelming increase in the importance of higher education in our national scene. The pressures of an increasing college age population and an increasing college-going rate has placed a great demand on our higher educational institutions. Beset with these external pressures, there were great internal pressures for institutions to expand in size and scope to meet the demand for higher education. As a result, institutions have eagerly sought and accepted increased levels of state, federal, and foundation funds for research, fellowships, building programs, increased educational offerings and other uses.

One result of this period of expansion is a highly sophisticated system of higher education in Illinois and the nation. But there are other results. There is an excessive dependence on federal and foundation sources of income by all institutions, but particularly the large private institutions. There is a great demand on state resources by public colleges and universities attempting to maintain comprehensive educational programs begun within the decade. And, there is a struggle for survival by small private colleges and universities who do not qualify for large amounts of state assistance (if any) and who have been passed by the federal government in its preference for supporting a small selected group of universities.

Now we face the decade of the seventies with new realities:

1. The growing realization that financial resources--State and Federal--will be increasingly limited.

2. College age population will peak in 1980, but college age no longer means the 18 to 22 age group. There will be growing demands for new kinds of educational experiences for new types of students.

3. There is a duplication of effort resources and programs among all institutions--public and private.

As a result of these pressures, the recent issuance of MP III addressed the issue of how the State of Illinois can achieve the greatest effectiveness in utilizing its existing higher educational resources. In other words, what innovative means are available to obtain more academic programming or service without impairment of the quality of education in the system.

The two chief recommendations relative to the satisfactory resolution of this issue were to:

1. Develop an integrated system of higher education--one statewide network, calling upon and utilizing to the fullest extent possible the resources of public and private colleges and universities.

2. Establish a Collegiate Common Market to facilitate the sharing among institutions of programs, facilities, and staff, with maximum ease of transferability throughout the system.

The Collegiate Common Market concept as a mechanism for the operation of an integrated system of higher education is not meant to suggest that individual institutions yield their local and particular distinctions. Rather, the concept calls for the abolishment of the traditional barriers between the institutions in an effort to maximize the delivery of education within the system. Ideally, the student would have access to the resources of the entire higher educational system. Thus, the quality of his educational experience would be significantly enhanced.

Statewide Computer Resource Plan Development

It is against this background that the study of computing resources in the state was begun. It is one of the first times (if not the first time) that the traditional barriers between Illinois institutions have been removed in the computer area in an attempt to provide a planned approach to computing activities.

Equal access to computing capability and equal opportunities for knowledge about computers and their applications are clearly two educational needs that fall within the Collegiate Common Market concept. This is surely not the current situation. Analysis of data collected as part of the current study indicates that student exposure to computing at institutions with computers ranges 0.7% to 55%(1) of the student population. Cost per student for instruction ranges from $7.00 to $693.00.(2) These figures indicate a wide range in the effectiveness of resource utilization. The picture for administrative and research computing is comparable. Sensing this distribution, the Board of Higher Education directed that a Statewide Plan for Computing Resources be developed that would include both public and private institutions of higher education.

As a result, the Board staff sought to develop such a plan by maximizing institutional involvement in its creation. Three committees were established. The Steering Committee consisted of members of those institutions interested in the plan development. Its purpose is to provide a forum for the discussion of the plan as it develops. The Technical Committee exists to determine higher education's needs for computing resources, and to design technically feasible alternatives to provide for those needs. The Policy Committee exists to select a set of alternatives for recommended implementation as the State Plan and to recommend policies necessary for implementation.

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Early in the study, it was determined that due to the current financial limitations, the Board staff would have to take a more active role in the development of the plan than had originally been anticipated. Consequently, two staff members have been assigned full-time responsibility for the project. Two consultants have also been employed to aid in the development of the plan. They are Dr. R. L. Martino and Mr. James Farmer. Dr. Martino was the consultant for the development of IMPACT 70's, the computer plan for the state agencies. Mr. Farmer was responsible for the development of a computer network at the California State Colleges. The cost of these consulting services is being shared equally with the Department of Finance. Mr. John Gentile, Deputy Director of the Department of Finance, is also contributing time to the effort.

These five individuals are collectively termed the "Task Force" and it is their responsibility to insure that objective studies leading to the development of the plan are completed and that inputs from those affected by the plan are considered. Thus far, to carry out the second part of the Task Force's charge, presentations have been made to the Board of Higher Education, the Public Junior College Presidents, and the Student Advisory Committee. You have been handed copies of the Board of Higher Education presentation. Our purpose here today is similar to the previous meetings. We would like your reactions and a policy statement relative to some issues that will be presented today.

Issues

The question is one of determining how to apply and effectively utilize the computing resources to serve the needs of the functional areas of administration, instruction, research, and public service. The resources are three: hardware, software, and human. The fourth resource, finance, is limited and must be applied to provide the first three resources in the most effective manner. The issues which we wish to discuss this morning are also three: a network of computer resources, a statewide computing institute, and computer based education.

Any statewide plan must provide a more cost/effective approach to the computing needs of the participating institutions than they are currently experiencing. Currently the feeling exists that control of computing hardware and software development aids the control of the administrative process. The task force believes that this belief is misdirected. Control of administrative processes lies not in the control of the "computer room" but in good management via user control, access, and interpretation of the data processed in the computer room -- regardless of the location of that room.

Current total costs for the administrative applications necessary for production of that data vary widely. Costs per student vary between $6.00 and $153.00 for administrative applications. There is no correlation between the cost of administrative data processing as a function of institutional size nor as a function of applications in a productive status. The lack of such correlation indicates either a very diverse pattern of utilization or a lack of planning and control. If the latter is true, the existence of the "computer room" and its services on campus have certainly not demonstrated its benefit in controlling its own processes.

The task force feels that the solution to the problem is twofold. First is the immediate provision of a well managed network providing administrative computing capabilities. Second, is the long range development of an appropriate Data Management System, capable of being driven by administrative users. The implementation of these solutions is open for discussion today. The task force favors the third party approach, i.e., a service organization governed by a Board of Directors outside the traditional institutional structure.

A second issue involves the provision for education about and using the computer. The instructional subcommittee will probably propose that by 1980, 90% of the entering freshmen should have some educational contact with the computer. The need for such percentages is not unrealistic. Dr. Edward David, Jr., Science Advisor to President Nixon, has remarked that we face the challenge of "converting the image of computers from the image of an unwelcome intruder -- a disagreeable agent of change, to the image of a benevolent helper and resource for our country". Should the higher educational community accept this challenge, the requirement of 90% of the entering freshmen is not unrealistic.

Again, due to economies of scale, providing the computing resource necessary to accomplish this task is probably best done by a network. However, there is more to this issue than the provision of computing capability. Course material will not be altered to include computer usage unless the instructors are familiar enough with the computer to do so. The task force feels that a statewide computing institute, perhaps using the resources of one university, is the solution to this problem. Such an institute should be considered to have a wider mission than faculty training. Certainly there is the need to keep administrative staff current. There is also the need to think of the "customers" of the institute in a broader sense. State and industrial employees also should be considered as potential users of the services offered by such an institute.

The final consideration is how to factor computer based education (CBE) into the statewide plan. Such systems are technically feasible today. Examples are PLATO, PLANIT, and TICCET. The question is more one of demonstrating the educational viability and cost/effectiveness of these systems when compared to the traditional methods of instruction. The task force feels that the PLATO system is worthy of a commitment to it as the system for delivering CBE within the state. Recommendations on how this commitment should be made are still under discussion. Perhaps testing should be conducted by a section of the statewide computing institute. Certainly CBE should be considered as just one of the modes of applying educational technology to improving the educational process. Some very serious thought should be given to how all these educational technologies can best be applied to present an integrated approach to improvement of the educational process.

The issues of the networks, statewide institute, and computer based education seriously affect the private institutions and their relationship to the Collegiate Common Market. It is our intent to discuss these issues in more detail with you at this time. No firm commitment has been made as to the details of how systems to resolve these issues will be structured and implemented and thus, our discussion this morning will be most beneficial in structuring our approach.

To orient our discussion, perhaps it would be best to summarize the issues by a series of statements and questions to you as representatives of the private institutions in the state.

STATEMENT: It is very likely that some form of computer sharing would result from the plan under development. The impact of such sharing would be:

.. no reduction in the institutions program autonomy
.. a likely reduction in unit cost of computing

.. the dependence upon a data center for computer operations which can be detailed in a user-provider contract
.. use of prescribed data center standards

QUESTION: Would the private institutions be interested in participating in the computer resource sharing program likely to develop? Note: Sharing would be on a reimbursable basis.

STATEMENT: Training in computer sciences is required for faculty, administrative staff, state employees, and industry. It has been proposed that a computer institute be developed for this purpose with perhaps adjunct professors conducting courses off campus.

QUESTION: Would your institution be interested in such a program to answer some existing needs in computer education?

STATEMENT: Computer based education systems such as PLATO are coming of age after many years (11) of development.

QUESTION: Is your institution interested in sharing in the implementation (when ready) of CBE?

STATEMENT: Various institutions have developed poor to excellent applications programs such as payroll, library systems, and student registration.

QUESTION: Would your institution be interested in sharing the "excellent" programs and discarding the poor ones?

APPENDIX I

Results of Questionnaire on Proposed Policy Statement Prepared by the Task Force and Steering Committee Appointed by the State Board of Higher Education to Study the Feasibility of a State-Wide Computer Network

January, 1972

Question No. 1 - Do these policies seem reasonably acceptable for your institution?

Question No. 2 - Do you think they will be beneficial to private higher education?

Question No. 3 - Would you recommend the Federation to lend its support to the adoption of these policies by the State Board of Higher Education?

NAME OF COLLEGE	Question No. 1			Question No. 2			Question No. 3		
	Yes	No	Uncertain	Yes	No	Uncertain	Yes	No	Uncertain
Art Institute Schools			✓	✓			✓		
Augustana	✓			✓			✓		
Barat College	Share facilities with Lake Forest								
Blackburn College	✓			✓			✓		
Bradley University	✓			✓			✓		
College of St. Francis	✓			✓			✓		
Concordia Teachers Coll.	✓					✓	✓		
Elmhurst College	✓			✓			✓		
Eureka College	✓			✓			✓		
George Williams College	✓			✓			✓		
Greenville College	✓			✓			✓		
Illinois Benedictine	✓					✓	✓		
Illinois College	✓			✓			✓		
Illinois Institute of Tech.	✓			✓			✓		
Judson College	✓				✓				
Kendall College	Conditions and policies not applicable to private, 2 yr. institut								
Knox College	✓			✓			✓		
Lake Forest College	✓			✓			✓		
Lewis College	✓			✓			✓		

NAME OF COLLEGE	Question No. 1			Question No. 2			Question No. 3		
	Yes	No	Uncertain	Yes	No	Uncertain	Yes	No	Uncertai
Loyola University	✓					✓	✓		
Monmouth College	✓			✓			✓		
North Central College	✓			✓ (But not in near future)			✓		
North Park College			✓			✓			✓
Northwestern University	✓			✓			✓		
Olivet Nazarene Coll.	✓			✓ (a qualified yes)			✓ (a qualified yes		
Principia College	✓			✓			✓		
Quincy College	✓			✓			✓		
Robert Morris College	✓			✓			✓		
Rockford College			✓			✓			✓
Roosevelt University	✓			✓			✓		
Rosary College	✓			✓			✓		
Trinity College	✓			✓			✓		

APPENDIX J

COAST COMMUNITY COLLEGE - A CASE HISTORY OF EDUCATIONAL COMPUTING

Background

The Coast Community College District has two community colleges: Orange Coast Community College with 16,761 students and Golden West Community College, a new college, with 8,636 students in 1969. Although the Coast Community College District has a similar mission to the other community colleges in California and serves a suburban community in Orange County not too unlike other Los Angeles and San Francisco suburban communities, it has had a long history of campus commitment to instructional data processing. Unlike other campuses which began data processing in administration, usually admission and records, Coast Community College District made a major commitment to develop a data processing capability which could be used by all faculty and students to improve their educational experience. The campus offered some courses in data processing, introduced data processing into other courses, such as mathematics, accounting, and statistics, where knowledge of the computer was important to course content, and in marked contrast to most other institutions, began to use the computer as a method of instruction.

This was not a program which just developed by virtue of having a powerful computer on campus, but rather was a conscious decision of the Chancellor and Trustees to make a major investment in this method of instruction. For this reason -- the carefully considered decision and plan -- the use of the computer has developed quite differently from the use of computers on other campuses, including the major universities. The colleges had, as a planned objective, the development of instructional materials related to specific courses.

Orange Coast Community College was located near the Irvine campus of the University of California. From the beginning of this new University campus, it was intended that UCI would integrate the use of the computer in instruction, research and administration. Considerable effort by the campus, IBM, and other research sponsors was generated to develop computer applications. However, the results failed to meet the expectations of the campus faculty and administration, and much of the work was never applied. But Orange Coast Community College was able to make use of the concepts developed at Irvine, e.g., the computer language, CAL-APL, developed for instructional materials (an adaptation or extension of APL), and the knowledge that had resulted from several years of development and experimentation.

Instructional Computing

The Coast Community College District adopted a two point policy on instructional use: the computer would be readily available to the students, and there would be a sponsored development of instructional materials.

A visit to Orange Coast Community College -- the largest campus and site of the computing center -- demonstrates this commitment. The students have a special room with keypunches and an input-output station to the computer located in the next room. The campus has an IBM System 360 Model 50 computer with a card reader and a printer located in this student area -- the two areas being separated only by a glass partition. There are sufficient keypunches, some 20 to 30, so that student queues are short. This facility supports the requirement for processing student batch jobs. The center is available from 6:00 A.M. until 2:00 A.M. weekdays, and is generally available on weekends and holidays. Clearly there is student access.

In two adjacent rooms there are some 50 typewriter-type terminals to support APL as an interactive language and CAL-APL for instructional materials. Students have general access to the terminals (though they may be used occasionally for scheduled classes) and can pursue course materials at their own speed according to their own schedule. Additional terminals are available at Golden West College, and to extend access even further, terminals are being installed in a new Orange County Public Library building. To assist the student, there are student assistants available in the area. During typical college hours, there are faculty members in the immediate area. The students are provided the facility and assistance to make full use of the computing capability. Every effort has been made to accommodate the needs of the students, which in turn, has permitted the college to achieve high utilization of the computer and facilities necessary for economic operation.

Perhaps the most innovative approach to development of instructional materials has been the college sponsorship of material preparation. An instructor who feels that computer instructional materials would improve the method of instruction, course content, or student performance, prepares a proposal outlining the types of materials needed, the resources, including his own time, needed to develop the materials, and the expected results from using the materials. These proposals are reviewed by a faculty committee and the college administration. Approval of the proposal provides the resources, including faculty released time, and a commitment to use the resulting materials. Typically the proposals have been made by instructors who are preparing their own materials want only small amounts of released time (e.g., 20 to 50% for one semester), require only limited technical assistance, and plan to immediately implement the results. As a result, there has been a great deal of instructional materials development with costs considerably below commercial and governmental estimates. This results primarily from the intense interest on the part of the Coast Community College faculty in the results of their teaching.

Although the campus faculty is not unanimous, most faculty members are pleased with improved student performance. From a research point of view, it is not possible to assess the impact of computer aided instruction. The improved student performance may be as much the result of intense faculty interest in teaching as it is in the development and use of instructional materials. It may also be that the development of instructional materials for the computer has increased interest in the development of instructional materials in general. Coast Community College District has also encouraged the development and use of audio visual and educational television materials. It may be that the commitment of the college to instruction has produced the high level of student performance and motivation, and that the instructional computing program is only the result of that commitment rather than a cause. In any case, the students, many of the faculty, and the administration feel that computer aided instruction has improved the educational experience.

Administrative Data Processing

The Coast Community College District made a conscious decision several years ago to defer large-scale implementation of administrative data processing. They felt that: (a) instruction should have the priority on resources during the development of a computer capability, (b) the administrative processes were not well defined for the modes of instruction and community service which the administration and Trustees wished to pursue, and (c) there were many projects underway in other institutions which focused on administrative data processing.

In the meantime, the developments of the National Center for Higher Education Management Systems (NCHEMS at WICHE) have identified some common data elements, classifications, and reporting formats, the California control agencies -- the Coordinating Council, Legislature, and the new California Community Colleges central office -- have specified reporting requirements, and research in the administrative processes have suggested several design approaches not available earlier. Thus, the Coast Community Colleges are now in a position to develop and implement many of the administrative systems without going through intermediate designs and implementations.

APPENDIX K

TYPICAL PUBLIC UNIVERSITY ADP APPLICATIONS[*]

FINANCIAL SYSTEMS

Bank Reconciliation
Benefit Accounting
Budget Preparation
Civil Service
Departmental Cost Accounting
Equipment Inventory
General Fund Expenditure Accounting
Movable Equipment
Obligation Accounting
Payroll
Personnel Budget Control
Purchasing
Registration Fees
Student Loan Accounting
Student Loans
Student Registration Fees

STUDENT SYSTEMS

Admissions
Admission Records
Class Roster
Composite Entrance Test
Course Changes
Course Master Schedule
Enrollment Forecast
Enrollment Reporting
Enrollment Statistics
Grade Reporting
Housing Reports
Selective Service
Student Directory
Student Ethnic Reporting
Student Fee Assessment
Student Financial Aids

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[*] As reported on at least six of the twelve campuses responding to a questionnaire "A Plan for the Uses of the Computer for Institutions of Higher Education in Illinois."

STUDENT SYSTEMS

Student Records
Student Registration
Student Transcript Master
Test Analysis
Undergraduate Admissions

INSTITUTIONAL RESEARCH AND REPORTING SYSTEMS

Administrative Research
Administrative Studies Information
Course Data Collection
Faculty Activity Reporting
Faculty Biographical Data
Faculty Clock Hour Reporting
HEGIS-Personnel Department
HEW-Compliance Report
Space Analysis
Space Inventory
Space Utilization Annual Reports
Staff Race/Ethnic Reporting
State Board Cost Study

MISCELLANEOUS SYSTEMS

Faculty/Staff Directory
Faculty/Staff Mailings
Library Serials Holdings

APPENDIX L

MANAGEMENT INFORMATION SYSTEM

By: Dr. Rocco L. Martino

THE MIS CONCEPT IN GENERAL

By concept, a Management Information System must be the result of an integrated system. Subsystems are the by-product of an MIS, rather than the converse. As a result, the concept may be embodied within the following definition:

> An MIS is responsive to the predicted and unpredicted, structurable and non-structurable functions of management in setting objectives, allocating resources, and administering decisions; and towards these ends, an MIS functions by
>
> .... measuring the impact of decisions before and after they are made
>
> .... measuring the environment
>
> .... reacting in a time-frame to make reaction meaningful

From the definition itself, it is apparent that the functional areas of an MIS revolve about:

- - - data organized to meet the needs of all users in their necessary time-frame
- - - software and hardware capable of meeting user needs for updating, retrieval, analysis, and presentation
- - - an integrated design to begin with

Since so many unsuccessful systems have been caused by communication problems between user and specialist, success will depend on the ability to break the dependence on the specialist for overall design and control. The user orientation can only be insured by user involvement in the specification and design stage, and in making a user-oriented vendor-independent DMS mandatory.

With a DMS, the software and the situation come into alignment, with the resultant ability to simplify immeasurably the amount and complexity of the work required to get an MIS operational. This is shown in Figure 1.

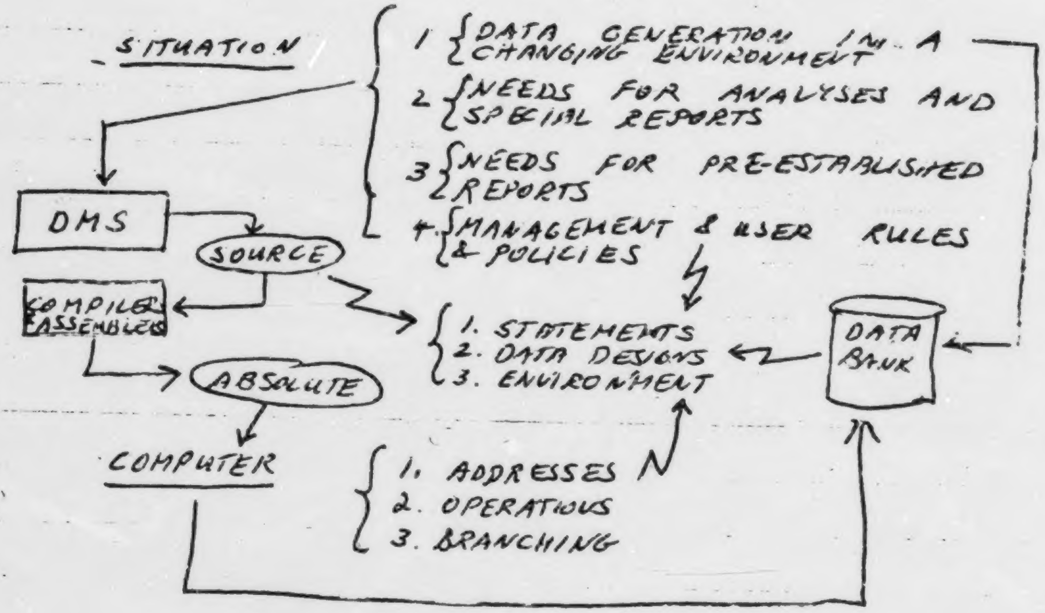
SITUATION
1 DATA GENERATION IN A CHANGING ENVIRONMENT
2 NEEDS FOR ANALYSES AND SPECIAL REPORTS
3 NEEDS FOR PRE-ESTABLISHED REPORTS
4. MANAGEMENT & USER RULES & POLICIES
DMS
SOURCE
COMPILER ASSEMBLER
ABSOLUTE
COMPUTER
1. STATEMENTS
2. DATA DESIGNS
3. ENVIRONMENT
DATA BANK
1. ADDRESSES
2. OPERATIONS
3. BRANCHING

FIGURE 1
SITUATION - COMPUTER LINKAGE
WITH A D.M.S.

Figure 2 presents another view of the same concept.

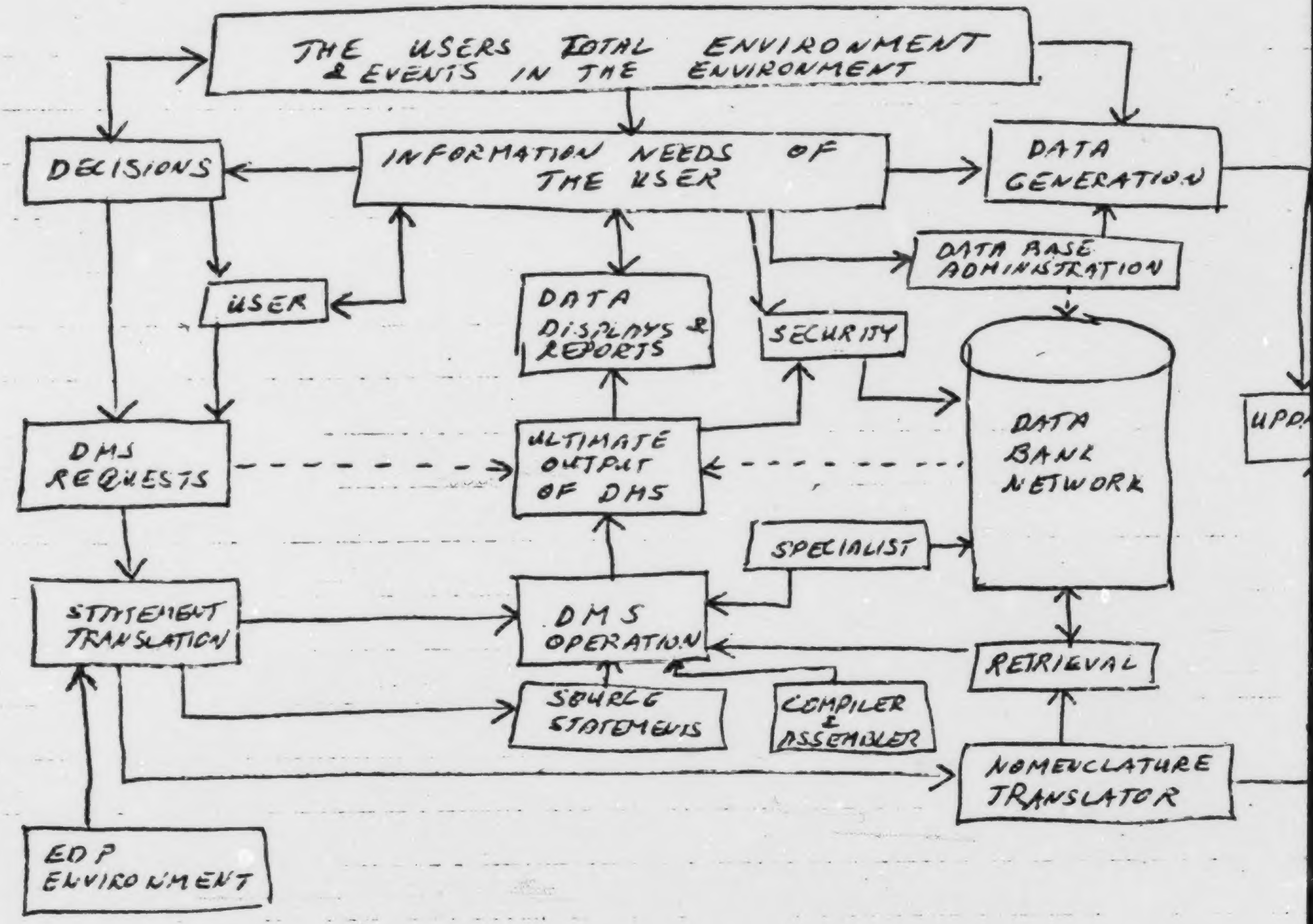

FIGURE 2.
MORE DETAILED VIEW OF
USER - DATA BANK - D.M.S. LINKAGES

The general approach here is one of:

- - - flexibility
- - - adaptability
- - - response

From a more practical point of view, there is a need to relate operations activity in an organizational entity to the MIS as a whole. A generalized form of such a relationship, directed to higher education, is shown in Figure 3.

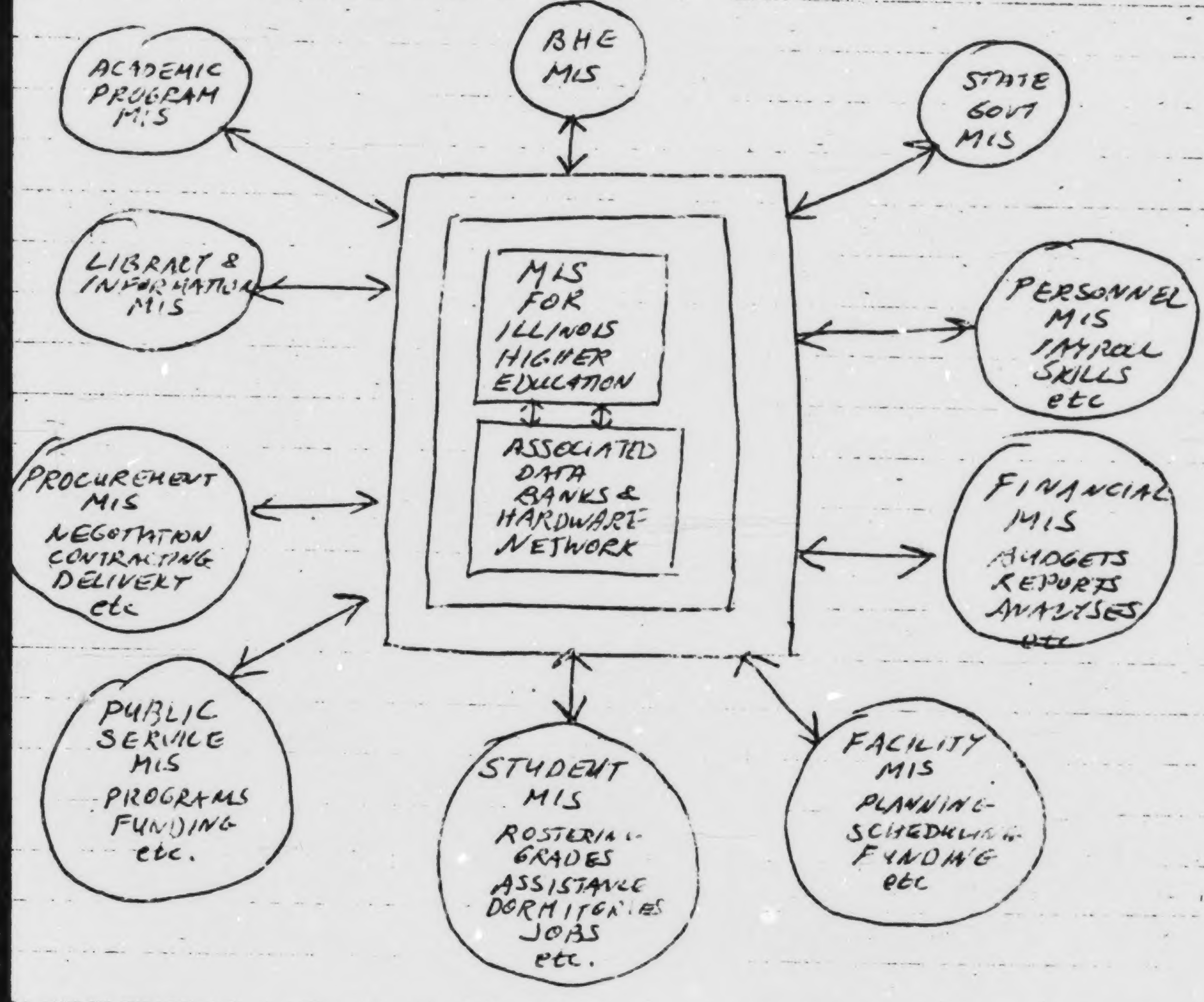
BHE MIS
ACADEMIC PROGRAM MIS
STATE GOVT MIS
LIBRARY & INFORMATION MIS
MIS FOR ILLINOIS HIGHER EDUCATION
ASSOCIATED DATA BANKS & HARDWARE NETWORK
PERSONNEL MIS PAYROLL SKILLS etc
PROCUREMENT MIS NEGOTIATION CONTRACTING DELIVERY etc
FINANCIAL MIS BUDGETS REPORTS ANALYSES etc
PUBLIC SERVICE MIS PROGRAMS FUNDING etc.
STUDENT MIS ROSTERING GRADES ASSISTANCE DORMITORIES JOBS etc.
FACILITY MIS PLANNING SCHEDULING FUNDING etc

FIGURE 3
S4B SYSTEM REPORT & INFORMATION
NETWORK CONNECTED WITH INTEGRATED MIS

In order to create such a system from conception to other, it is necessary to follow the general sequence of activity as shown in Figure 4. A more detailed arrow diagram is attached as Figure 5.

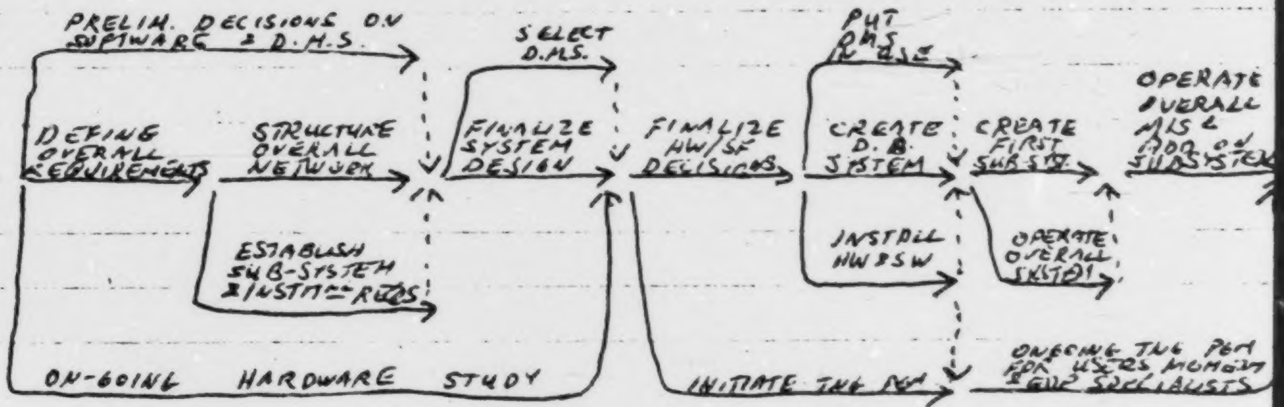
PRELIM. DECISIONS ON SOFTWARE & D.M.S.
SELECT D.M.S.
PUT DMS IN USE
OPERATE OVERALL MIS & ADD ON SUBSYSTEM
DEFINE OVERALL REQUIREMENTS
STRUCTURE OVERALL NETWORK
FINALIZE SYSTEM DESIGN
FINALIZE HW/SF DECISIONS
CREATE D.B. SYSTEM
CREATE FIRST SUB-SYS.
ESTABLISH SUB-SYSTEM & INSTIT. REQS
INSTALL HW & SW
OPERATE OVERALL SYSTEM
ON-GOING HARDWARE STUDY
INITIATE THE PGM
ONGOING THE PGM FOR USERS MGMT & EDP SPECIALISTS

FIGURE 4
SIMPLIFIED NETWORK FOR
MIS DEVELOPMENT

With regard to the State of Illinois, it is recommended that the Financial and Academic sybsystems proceed as rapidly as possible. The Library subsystem would proceed at the same time provided personnel resources are available. Indeed, the pace of development to the point of full-scale operation will depend on resources available; and the most important resource will be people. However, the DMS approach and the newer software systems should make greater practical use of "user" personnel which would materially enhance the personnel resource level.

A very important ancillary consideration is the involvement of management -- top, line, and supervisory -- in all aspects of problem definition and system specification. Without their active support and involvement, the system:

- - - may never be implemented

- - - may never respond to their needs even if implemented

- - - will never have their full confidence.

As a result, the program of committees and visits should be augmented by a specially prepared management orientation program that would:

- - - define necessary concepts (MIS
    (DMS
    (HW/SW
    (DATA BANKS
    (NETWORKS

- - - consider organizational areas (THIRD PARTY
    (PUBLIC/PRIVATE
    (EDUCATION/GOVT.
    (SENIOR/JUNIOR
    (PUBLIC SERVICE

- - - examine financial areas (BUDGETS & LINE ITEMS
    (GRANT FORMULAE
    (PROGRAM FUNDING
    (HW-SW COSTS & FUNDING
    (STATEWIDE LEASING

- - - establish cost/benefit criteria (QUANTITATIVE
    (QUALITY OF LIFE
    (PERSONAL PURPOSE
    (NATIONAL GOALS
    (STATE GOALS

Such a program is strongly recommended as a necessary ingredient for a successful design and implementation program.

PRELIMINARY MIS CONCEPTS FOR HIGHER EDUCATION IN ILLINOIS

A Management Information System for Higher Education in Illinois must be designed to satisfy three major objectives, viz:

- the specific and particular needs of each institution in the system
- the foreseen and unforeseen needs of the governing and legislative bodies in the state (and outside) concerned with academic and financial concerns
- the requirements of the people and the law for service and the protection of privacy.

To meet these overall objectives, such a system must be designed to include:

- an integrated data-bank network
- extensive controls on data updating, retrieval, security, accuracy, and timeliness
- agreements on responsibility for data creation, data input to the system, ability to "browse", and multi-institution use of single institution data
- agreements on organization of the data, including standard formats and terminology at the central data bank, with conversions to individual or institutional formats and nomenclature
- adoption of a standard language that is vendor-independent, user-oriented, free-form, easy to use, and economical to use
- a third party operator of the system
- an architectural approach that creates maximum efficiencies on both updating and retrieval by:
    - updating as if to a single bank
    - retrieving from clusters and nests
- extensive presentation capability
- open-ended application systems.

Such an approach differs from some of the historic attempts to create integrated systems. This approach eliminates:

- - - the need for a common data element dictionary
- - - the need for standard nomenclature
- - - the need for common subsystems
- - - a heavy dependence on technicians for applications
- - - long time cycles on special reports
- - - vendor dependence
- - - extensive retraining
- - - disruptive struggles for "control".

From an operational point of view, this type of system will functionally operate as a single data bank for updating, and a network of "dedicated" sub-banks for analysis and retrieval, i.e., a system of "image" clusters built for each operational area. In that way, each institution will appear to function with a dedicated system, while each operational area will also appear to have an "image" dedicated system. The general concept is shown in Figure 1.

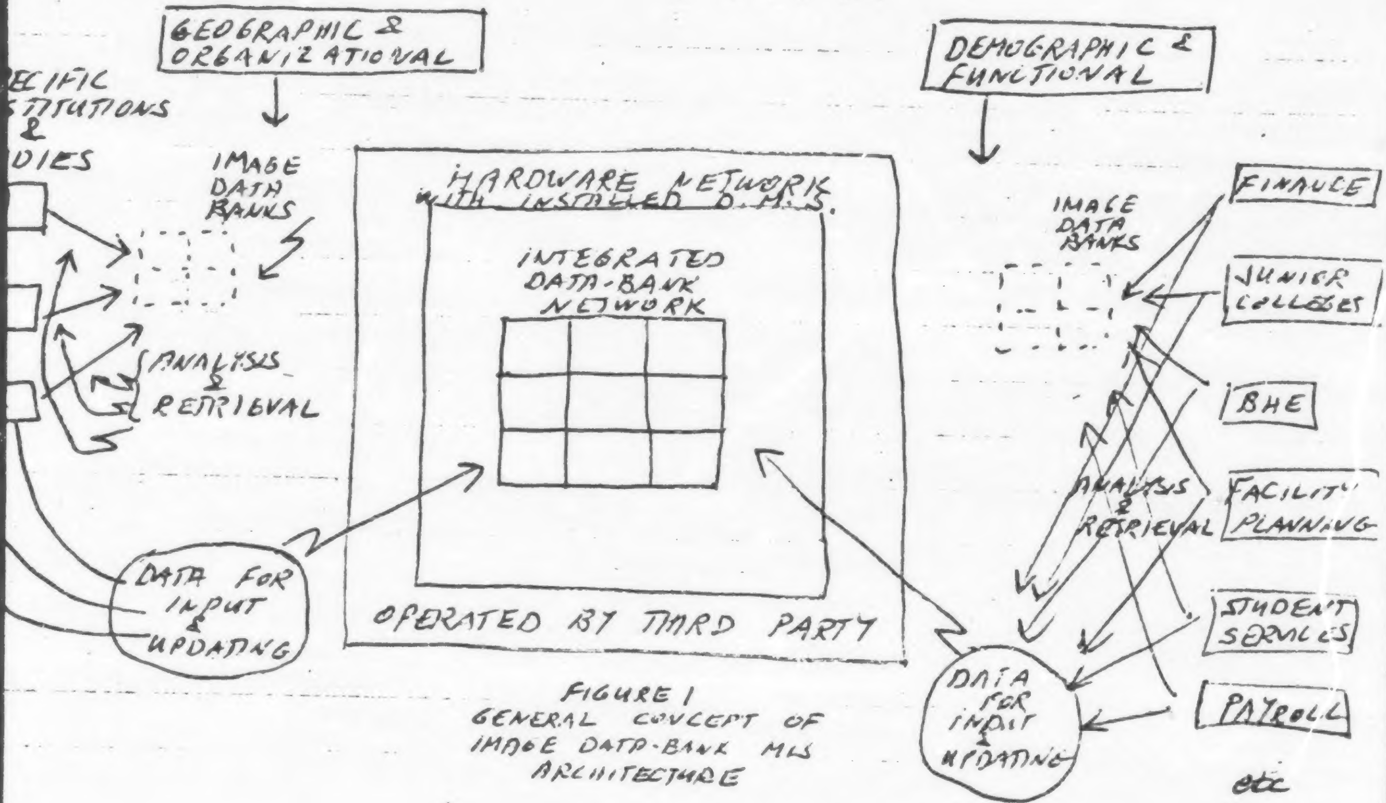

FIGURE 1
GENERAL CONCEPT OF
IMAGE DATA-BANK MIS
ARCHITECTURE

As a result, the system will simultaneously provide capability for:

- - - reports by geographic or organizational entity

- - - reports by demographic or functional area

- - - analyses based on all the data

- - - re-arrangement of data organization

- - - valid, secure, and accessible data.

Further details of the general philosophy of this concept, and details of the D.M.S. (Data Management System) are included in IMPACT 70's, Volume II.

From a practical point of view, there is a need to:

- - - develop a plan and schedule of creation, programming and implementation

- - - develop cost-benefit criteria

- - - establish a set of policy guidelines to meet the several (and sometimes differing) objectives of the institutions, the Board of Higher Education, the Bureau of the Budget, and other governing bodies.

The suggested mechanism is to use the findings of the administrative data processing subcommittee of the technical committee, amplified by the recommendations of the technical committee and the steering committee; coupled with the detailed work of the Task Force including visits, meetings, and special analyses. The general sequence of activity would be as shown in Figure 2.

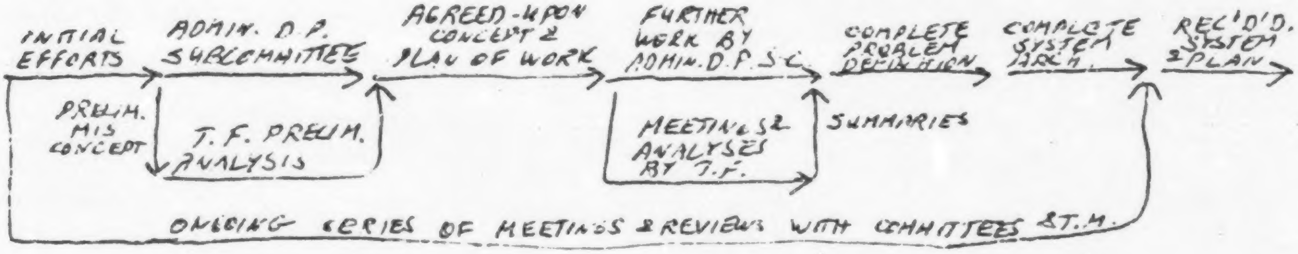
INITIAL EFFORTS
ADMIN. D.P. SUBCOMMITTEE
AGREED-UPON CONCEPT & PLAN OF WORK
FURTHER WORK BY ADMIN. D.P. S.C.
COMPLETE PROBLEM DEFINITION
COMPLETE SYSTEM ARCH.
REC'D'D. SYSTEM & PLAN
PRELIM. MIS CONCEPT
T.F. PRELIM. ANALYSIS
MEETINGS & ANALYSES BY T.F.
SUMMARIES
ONGOING SERIES OF MEETINGS & REVIEWS WITH COMMITTEES & T.M.

FIGURE 2
SUMMARY NETWORK
FOR SEQUENTIAL
LINKAGES

In a more detailed fashion, it is necessary to:

- - - take inventory of current (data
  - (applications
  - (reports
  - (established requirements
  - (established subsystems
  - (hardware capability
  - (software
  - (personnel
- - - isolate common subsystems or applications
- - - isolate common data elements and terminology
- - - establish realistic volume projections
- - - establish realistic response intervals
- - - establish collection procedures for data
- - - study the needs for privacy, security, and accuracy.

These more detailed analyses are incorporated in the overall arrow diagram prepared as of September 1. Three major activities in that network are (67 ,68), (68 ,69), and (81 ,82). These are detailed as follows:

1. Major Analyses and Reports Required for Problem Definition Activity (67 ,68)

- - - Privacy, security and access control
- - - Equipment and data bank networks (1)
- - - Total load for administrative data processing by institution and governing body, by application area, to 1980
- - - Data input problems and requirements connected with
  - --- libraries
  - --- financial systems
  - --- student areas
  - --- faculty and staff areas
  - --- facility planning, maintenance and use
- - - Major subsystems including
  - --- personnel skills, including a teacher job-bank
  - --- payroll

- accounting and auditing
- load analysis and projections
- facility planning and scheduling
- student affairs and services
- library
- personalization
- public affairs

- Cost/Benefit criteria and analyses of present system and alternatives
- Data element cataloguing and impact of free-form Data Management System
- Information Services to public institutions, students, Board of Higher Education, and state-local-federal government bodies
- Response intervals needed on regular and special reports
- All other necessary studies required for final report.

Note (1) The use of the term network may presuppose that decisions on architecture have been made before the study commences. This is not so. A network exists at the present time, without linkages. The recommended system could be the current non-connected approach at one extreme, or a single system at the other. A balanced and integrated approach lying somewhere between these extremes would appear to be in order.

2. Major Elements of System Design and Implementation Progress Activity (68 ,69)

- - - Linkages with other states and the Federal Government

- - - Linkage with IMPACT 70's

- - - Impact and linkage with other agencies such as

    --- MID

    --- Office of Education

    --- National Science Foundation

    --- HEW

    --- Board of Higher Education

    --- Department of Labor

- - - Impact of MP-III

- - - Impact of state budget and audit requirements, including EDP line items

- - - Specific and directed subsystem and data bank requirements of top management

- - - Special needs and problems of

    --- Junior colleges

    --- Multi-campus institutions

    --- Private institutions

- - - Service potential of the network to

    --- local governments

    --- local school boards

    --- private institutions

    --- public education

- - - Special innovative programs in public sector

- - - Student desires and requirements re

    --- privacy

    --- personalization

    --- service

- - - Establishment of nests and clusters of data

- Establishment of detailed preliminary MIS design including
  - data bank network architecture
  - data conversions
  - data element translators
  - data management
  - equipment needs
- Requirements to ensure privacy, control, access, and security of data
- Impact of third party -- public corporation
  -- facility management cooperation
  -- state agency or commission
- Statewide self-leasing system and data bank
- Negotiated terms with vendors
- Impact on personnel and organizational structures.

3. Major Report Sections, Activity (81 ,82)

- Recommendations on
  - Statewide self-leasing
  - Public Corporation
  - System Responsibility
  - System Exchange
  - Data Responsibility
  - Privacy, access and security
  - New systems
  - Data Management System
- Projected Demand -- Cost and Impact
- System and software architecture
- Legal and legislative matters
- Acquisition or release of hardware
- Acquisition or release of software

- - - Cost/Benefit

- - - Linkages to
    - --- government bodies
    - --- institutions
    - --- public

- - - Implementation schedule

- - - Quantitative justifications

- - - Future planning
    - --- institutions
    - --- state

- - - MIS needs at all levels
    - --- institutions
    - --- government bodies
    - --- management

The SRG Report on Information System Design, together with IMPACT 70's, Volume II and the subcommittee reports can serve as working starts to the MIS report section. It is suggested that:

- - - copies of this working guide be circulated
- - - copies of IMPACT 70's, Volume II be circulated
- - - copies of the SRG report be circulated
- - - the members of the subcommittee be given specific assignments as just detailed.

Following the completion of the individual report sections, they should be consolidated into a single cohesive system for review and comment by the technical, policy, and steering committees prior to final editing and presentation to the Board of Higher Education on December 7, 1971.

N.B. Further details on philosophy, data bank concepts, MIS development, etc. are in IMPACT 70's, Volume II and in RLM books on MIS "Dynamics of MIS","MIS-Methodology", and "MIS".

APPENDIX M

MINI-COMPUTER APPROACH PROPOSED BY
MORRISON-ROONEY ASSOCIATES, LTD.

CONSOLIDATION APPROACH

During the course of this study communication network alternatives were investigated for the limited consolidation moves that were recommended. The main thrust in the future will be the complete consolidation concept as presented in IMPACT 70's and the soon to be released Higher Education Task Force report. Because of this forthcoming consolidation plan, the Team carried the communication network investigation further, on a gross level, with complete consolidation in view.

Typically, current centralized computer facilities are supporting 270x type networks made up of voice grade lines and typically these 270x oriented systems steal an inordinate number of main CPU cycles. Also, because of the future requirements for student express batch, interactive terminals, and remote batch a 270x network would be required to handle batch and another 270x network would be required to handle interactive terminals. An alternative approach would be a single network made up of mini-computers on each campus tied into a front-end communications processor at the central site via 50k b.p.s. lines. This concept would involve the following approximated hardware costs assuming the central site is University of Illinois at Champaign-Urbana:

DESCRIPTION	YEARLY COST
50k b.p.s. network	$ 375,000
Central Computer (duplex)	$2,640.000*
Front End Computer	$ 550,000
Mini-Computers (12@ $8,000 each)	$ 696,000
Undefined (20%)	$ 821,000
TOTAL	$5,082,000

The FY73 EDP equipment budget request (minus terminals) total was $5,442,000.00. On the surface it appears that this consolidation approach may be more economical.

Some of the advantages of this concept are:

.. Only one network to support all functions.
.. Capability to process limited number of jobs on campus.
.. On-line handlers limited to front-end processor at central site which frees main CPU(s) for
.. processing.
.. Limited modifications to the system when new users are added.

Probably the biggest disadvantages are:

.. Original cost of implementation.
.. Requirements for expertise to implement and maintain the system.

* IMPACT 70's duplex estimate.

There are, of course, several variations possible on this concept. One of which would be the use of a center in the northern part of the State and a center in the southern part of the State.

The Team feels that this concept is worth further analysis as follows:

- .. Gather details from each institution for development of specific network requirements.
- .. Work closely with General Services Telecommunications Group to develop network details and associated costs.
- .. Develop detail mini-computer requirements.
- .. Develop conversion costs.
- .. Develop detail central computer requirements.
- .. Develop detail front-end computer requirements.
- .. Develop the cost/performance justification (positive or negative).

Mini-Computer Configuration

DESCRIPTION	APPROXIMATE YEARLY RENTAL
Central Process (16k storage)	$ 11,520
Console	960
Card Punch (200cpm)	4,680
Line Printer (1200 lpm)	15,420
Magnetic Tape (2 units)	11,760
Communication Interface	4,800
Card Reader (1200 cpm)	6,000
Misc. Additional Features	2,860
	$ 58,000